THE GUNONG BENOM EXPEDITION 1967

6. THE DISTRIBUTION AND ALTITUDINAL ZONATION OF BIRDS AND MAMMALS ON GUNONG BENOM

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THE GUNONG BENOM EXPEDITION 1967

6. THE DISTRIBUTION AND ALTITUDINAL ZONATION OF BIRDS AND MAMMALS ON GUNONG BENOM

By LORD MEDWAY

SYNOPSIS

During 2½ months February to mid-April in 1967, and three weeks in February 1968, birds and mammals were collected and observed on the north-east flank of Gunong Benom from 600 ft to the summit at 6916 ft. Evidence from specimens autopsied confirms that these dates covered the start of the annual breeding season of birds, and was also a period when many mammals were pregnant or lactating. Totals of 191 species of birds and 81 species of mammals were identified. The greatest faunal diversity among both classes was recorded at lower altitudes, with a significant proportion of species present only below 1000 ft. With increasing altitude there was a regular decline in diversity, and only 31 bird species and 10 mammal species were recorded at 6000 ft and above. In both classes, the highland community above 4000 ft was distinct from the lowland community occurring below 2000 ft. The difference was most marked in birds, among which only one species, a cuckoo-dove, was found at all elevations. Among birds, also, at least six species showed a restricted distribution in middle altitudes, and among mammals one species, a bat, was found only at 6000 ft. Subjective assessments of faunal zonation are supported by calculations of Soerensen's coefficient for faunal communities of arbitrary zones separated by '000 ft contours. Bird-netting results are also analysed using a rank-correlation technique, which supports other findings, while emphasizing the distinctiveness of the sub-canopy fauna susceptible to capture by netting.

INTRODUCTION

THE bird and mammal faunas of Malaya are adequately known, and the distributions, including altitudinal limits, of most common species are recorded in publications including Robinson (1928), Gibson-Hill (1949) and Glenister (1952) for birds, and Chasen (1940), Harrison (1964) and Medway (1969) for mammals. Collection and observation, however, have been uneven. A disproportionate number of highland records have been made in the hill-station resorts (notably Cameron Highlands and Fraser's Hill), where settlement has opened up the country and undoubtedly affected the local ecology. Few observations have been made in the lowlands adjacent to these montane areas, and the intervening hillsides and the submontane zone have been poorly investigated.

The expedition to Gunong Benom thus offered an unprecedented opportunity to sample the birds and mammals of undisturbed forest on a continuous transect ascending one flank of a mountain which is among the highest in Malaya. The distance in plan from Base camp at 700 ft to the summit at 6916 ft is only 7 miles. The geology of the transect is uniform (Medway, 1972), and the vegetation is consequently determined by altitude and aspect, not by local peculiarities of parent rock or soil (Whitmore, 1972). At lower altitudes disturbance of the natural vegetation was limited and of recent occurrence, and above 1800 ft the climax forest persisted unaltered. As shown below, the isolated position of Benom has apparently prevented colonization by a few bird and mammal species found at high elevations on the Main Range or on Gunong Tahan. The degree of faunal impoverishment, however, is slight and does not materially affect the pattern of altitudinal zonation.

Although the bats collected included one undescribed species and one new to Malaya (Hill, 1972), the birds and mammals encountered were all either familiar or could be distinguished in the field and subsequently identified. It was thus possible to concentrate our efforts on the principal aim of establishing the altitudinal ranges of all species encountered. Results are presented below in the form of annotated systematic lists of birds and mammals. Patterns of distribution are examined subjectively, and have also been analysed mathematically by comparative calculations, which although simple appear to represent the first attempt to treat Malayan data on altitudinal zonation in a quantitative fashion.

METHODS

This paper is based on observations made during the Zoology Department, University of Malaya/British Museum (Natural History) expedition from 1 February –15 April 1967 (Medway, 1972) and during a subsequent return trip to Gunong Benom from 29 January to 18 February 1968. Records of occurrence summarized below are supported by evidence of several kinds, as follows:

1. Birds or bats (and one flying squirrel, *Iomys horsfieldii*) were trapped in standing mist-nets, all 12 m long by 2·4 m high with 36 mm mesh, set at low levels in the forest and open day and night. For practical reasons netting was confined to limited areas in the vicinity of each camp.
2. Small mammals were caught in traps set on the ground or on fallen logs, branches, etc. near ground level. Two types of traps were used: 50 British 'Longworth' small mammal traps, and 196 standard locally manufactured, cage-type, catch-alive traps baited with tapioca, banana or coconut flesh. All traps were set in lines, with an interval of 10 yards between traps. Trapping was most intensive around Base camp at 700–900 ft (Table 3), but traps were also set in a continuous transect in forest beside the north-east ridge path from 900–6300 ft. Six 'Special' traps designed to catch squirrels in English woodland were also tried, without success.
3. Specimens shot by day or (using a headlamp) by night.
4. Specimens caught by other means, e.g. by hand.
5. Sight-records of free-living birds or mammals by competent, experienced observers.
6. Tracks or dung.
7. Distinctive song or other vocalization.

Heights given in every case are the altitude above sea level to the nearest 100 ft of the net or trap, or of the collector or observer, ignoring the additional height of arboreal birds or mammals above ground. The heights of camps and conspicuous landmarks were established from the 1 : 63,600 map. Altitudes of intervening points were read from pocket anaeroid altimeters.

With birds, a representative collection was made of not more than twleve specimens of each species netted, the majority as rough-dried skeletons. Additional specimens surplus to requirements were ringed and released alive where caught, after being identified, measured and weighed. Surplus bats were also released alive where caught, but were not marked or banded. All animals shot or killed by other means, and all mammals trapped, were preserved as specimens; again, most were prepared as rough-dried skeletons.

All skeletons, most liquid-preserved specimens and a few skins have been deposited in the British Museum (Natural History), along with photocopies of the field records; the original field records remain with the author. Small reference collections were retained for the zoology museum of the School of Biological Sciences, University of Malaya, and for the Division of Vertebrate Zoology, Institute for Medical Research, Kuala Lumpur.

Systematic names and their colloquial English equivalents conform with Medway & Wells (in prepn.) foı birds and Medway (1969) for mammals.

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The data summarized in this paper were gathered by a cooperative effort involving virtually all participants in the expedition, whose names have been listed previously (Medway, 1972). I am also grateful for the assistance of Dr I. C. T. Nisbet, Mr K. W. Scriven and Mr Tan Choon Seng, who visited us in the field in 1967, and Mr L. C. Ratnam and Dr D. R. Wells who joined the return trip in 1968. Mr Lim Boo Liat kindly informed me of additional records of mammals obtained by I.M.R. personnel on subsequent visits to north-east Gunong Benom. Dr J. A. Bullock kindly advised on statistical procedures and provided the programme for the computation of τ, which was performed at the University of Malaya Computer Centre.

OBSERVATIONS

1. Birds

a. Resident species

Both visits by the author to Benom were made during the first quarter of the year, a period which marks the onset of the breeding season among the majority of resident terrestrial birds in Malaya (Gibson-Hill, 1952; McClure, 1968; much unpublished information in the University of Malaya Bird Ringing Project files). Observations of the reproductive condition of specimens autopsied are given in Appendix 1. In almost all adult males of every species, passerine and non-passerine, the testes were enlarged. Among females, 45 individuals representing 37 species were at or near laying condition, as indicated by the presence of at least one enlarged ovarian follicle not less than 3 mm in diameter or of an oviducal egg. Nesting by four species was observed, and dependent young of one other species were seen. Yet in the sample netted, independent juveniles formed a very small proportion of the total, even in late March and early April 1967. Moult, which follows breeding in all avian forest communities studied in Malaya (unpublished), was recorded only among nine resident forest species.

These data confirm that the birds of Benom also begin to nest at this time of year. The selective importance of altitudinal factors in the ecology of each species is presumably greater at the time of breeding than later, during dispersal of the young of the year and of post-breeding adults, and zonation will consequently be more rigid.

b. Migrants

Most migrants to Malaya during the northern winter are found in open or largely deforested country, including cleared land, marsh, swamp and foreshore. Only some 24 species (15 per cent of the total of 161 recorded migrants) occur in undisturbed forest, and their importance in the ecology of this habitat is unknown. Seven passerine species, four of which were common, and four non-passerines recorded on Gunong Benom were migratory. All proved to have a limited altitudinal zonation.

Systematic section

The records given below are shown diagrammatically in Table 1. The catches by mist-net only are summarized in Table 2.

Accipitridae

Only two specimens were collected: the Black Eagle, *Ictinaetus malayensis* at 800 ft, and the Rufous-bellied Eagle *Hieraaetus kienerii* at 1500 ft. Other observations (Table 1) are based on sight records, and probably fail to represent the true diversity and full range of diurnal raptors on Benom. The only eagle at all frequently seen and identified was the Serpent Eagle *Spilornis cheela*, recorded from 700–3600 ft.

Falconidae

A pair of Black-thighed Falconets *Microhierax fringillarius* was seen at a hole in the stump of a branch *c.* 110 ft up a tall tree, at 900 ft elevation in the disturbed forest north-east of Base camp; a further sight record was made at 1600 ft.

Phasianidae

No pheasants were seen or collected in 1967. In 1968, snare lines were set at 1500–1600 ft and 3500–3800 ft. Four Mountain Peacock Pheasants *Polyplectron inopinatum* were taken at 3500 ft near camp 3, and a Roulroul *Rollulus rouloul* and a female Great Argus *Argusianus argus* at 1600 ft. All three species undoubtedly have a greater altitudinal range. Clucking calls probably of the Mountain Peacock

Pheasant were heard one dawn at camp 4, 5000 ft. Calls attributed to the Great Argus were heard daily, from below Base camp to above camp 2½, and several display grounds were found in this range. It is not impossible that the Crested Argus *Rheinardia ocellata* was responsible for some of these, since Ulu Dong on the western slopes of Benom is one of the two localities in Malaya where this pheasant has been collected (Gibson-Hill, 1949). The display grounds of the two argus pheasants are said to be indistinguishable, and their calls very similar (Robinson, 1928). Calls of the Long-billed Partridge *Rhizothera longirostris* were heard at Base camp and at 3300–3500 ft, although no birds were seen or collected.

Columbidae

The Mountain Imperial Pigeon *Ducula badia* was common and conspicuous from camp 3 up to 6000 ft elevation. The only green pigeon identified was the Thick-billed *Treron curvirostra*, collected at 1800 ft; there were additional sight records of green pigeons, unidentified. The Little Cuckoo-Dove *Macropygia ruficeps* was the only forest bird recorded from below Base camp to above 6000 ft. At lower elevations daily flights were seen heading downhill in the morning and returning uphill each evening. The Emerald Dove *Chalcophaps indica*, although elsewhere occurring up to 4000 ft (Gibson-Hill, 1949), was found only in the vicinity of Base camp where two birds were netted.

Psittacidae

The Malay Hanging Lorikeet *Loriculus galgulus* was seen and heard by several observers from 700–3200 ft.

Cuculidae

The Indian Cuckoo *Cuculus micropterus*, identified by its distinctive call, was heard frequently from Base camp up to 2400 ft. The Large Hawk Cuckoo *C. sparverioides* was also identified by its call from 3900–5800 ft; the species has not previously been recorded from Benom, but is now presumed to be resident there. The Violet Cuckoo *Chrysococcyx xanthorhynchus* was heard and seen flying overhead once at 900 ft and several times at camp 2, and the Drongo Cuckoo *Surniculus lugubris* was found from 800–1600 ft. Four malkohas were recorded: the Black-bellied Malkoha *Phaenocophaeus diardi*, only near Base camp at 700 ft; the Chestnut-breasted Malkoha *P. curvirostris*, from 700–1700 ft; Raffles' Malkoha *P. chlorophaeus*, from the forest edge at 600 ft to the ridge below camp 2½ at 2400 ft; and the Red-billed Malkoha *P. javanicus*, from 700–2500 ft, considerably lower than the 5000 ft maximum altitude elsewhere, noted by Gibson-Hill (1949). The Greater Coucal *Centropus sinensis* was seen and collected from the track side at the forest fringe between Base camp and the Ulu Cheka Road, but did not extend to the forest proper; it is therefore excluded from Table 1.

Strigidae

Several owls were caught in mist nets at night; additional records were based on calls heard. The Mountain Scops *Otus spilocephalus* was widespread from 3500–6100 ft. This owl has previously been collected from Benom by Evans in 1923 (Chasen & Kloss, 1928), although the record was apparently overlooked by Gibson-Hill (1949). Its call—a soft, slow double hoot—in no way resembles the call of the Collared Owlet (cf. Robinson, 1928). The Reddish Scops Owl *Otus rufescens* was netted twice, at 700 ft and 5000 ft; its range is assumed to include intervening altitudes. The Collared Scops *O. bakkamoena*, was netted at 700 ft and its distinctive broken hoot was heard near camp 2. The Collared Owlet *Glaucidium brodiei* was recorded from 3600–6000 ft; its monotonous four-note call was invariably heard by day, and the one specimen netted was taken mid-morning.

Tytonidae

One female Bay Owl *Phodilus badius* was netted at night at 800 ft in disturbed forest. In addition to widespread lowland records (Gibson-Hill, 1949), Robinson (1928) has reported this owl from above 4000 ft on Fraser's Hill.

Apodidae

Six species of swifts were recorded. Of these, only the Silver-rumped Spinetail *Chaetura leucopygialis* has been listed in Table 1 since it alone appeared to have a restricted altitudinal range, with sight records from 700–1700 ft. Among the others feeding at varying heights above the canopy, the House Swift *Apus affinis* and the White-bellied Swiftlet *Collocalia esculenta* were each noted at 3600 ft (I. C. T. Nisbet); both species certainly have a more extensive altitudinal range. In February 1968, the migrant Pacific Swift *Apus pacificus* and a large spinetail *Chaetura* sp. were regularly seen high over the forest; the observers' elevation (700–2000 ft) is clearly irrelevant. In both years, the Black-nest Swiftlet *Collocalia maxima* was continuously present in large numbers, feeding above the canopy at all elevations from Base camp to the summit ridge; sight records were confirmed by a specimen netted at 6000 ft. At camp 4, 5000 ft, flocks of these swiftlets were heard flying over after dusk and before dawn although no colony was found. They were presumably roosting in a cave in the vicinity. To date, all known breeding sites of the Black-nest Swiftlet in Malaya are on off-shore islands (Gibson-Hill, 1949).

Hemiprocnidae

Only the Lesser Tree-swift *Hemiprocne comata* was recorded, from Base camp to camp 2.

Trogonidae

The two common lowland species, the Red-rumped Trogon *Harpactes duvaucelii* and Diard's Trogon *H. diardii*, were seen and collected from 700 ft and 1000 ft, respectively, up to 2500 ft. The Orange-breasted Trogon *H. oreskios*, more characteristic of submontane forest (Gibson-Hill, 1949), was seen only once at 1700 ft, and the montane Red-headed Trogon *H. erythrocephalus* was recorded from 3600–4200 ft. *H. erythrocephalus* has not previously been found east of the Main Range (Gibson-Hill, 1949).

Alcedinidae

Four red-backed Forest Kingfishers *Ceyx rufidorsus* and one black-backed *Ceyx erithacus*, were netted near the stream at Base camp. Sims (1959) has shown that the two taxa hybridise over much of their range and has suggested that they are best treated as conspecific. Since the Benom specimens were phenotypically distinct they have been listed separately. The ovary of the single female *C. erithacus* was minute and the specimen is assumed to have been a migrant (cf. Nisbet, 1968). The Chestnut-collared Kingfisher *Halcyon concreta* was netted near streams at 700 and 2500 ft, and is presumed to occur at intervening altitudes.

Meropidae

In February of 1967 and 1968 feeding flocks of Blue-throated Bee-eaters *Merops viridis* were common throughout the open country of the Cheka valley and also extended to 2200 ft in the ridge forest above camp 2. No local breeding sites were found or reported to us, and these birds were presumed to be winter visitors to the area. Despite searching, no records were obtained of Blue-tailed Bee-eater *M. philippinus*, which in the lowlands of western Selangor replaces the breeding population of *M. viridis* during the northern winter. The forest-dwelling Red-bearded Bee-eater *Nyctiornis amicta* was recorded from 1700–2700 ft.

Bucerotidae

The White-crested Hornbill *Berenicornis comatus* was recorded only in the neighbourhood of Base camp at 700 ft. Four other hornbills were conspicuous and widespread on the lower slopes of the mountain. The Wreathed Hornbill *Rhyticeros undulatus* was recorded up to 3900 ft, the Helmeted Hornbill *Rhinoplax vigil* up to 3500 ft, the Bushy-crested Hornbill *Anorhinus galeritus* up to 3400 ft, and the Rhinoceros Hornbill *Buceros rhinoceros* not above 2600 ft.

Capitonidae

The barbets as a group extended over the entire altitudinal range, within which each species proved to be restricted to a limited zone. Although few were collected, each species could be identified by at least one diagnostic call. It was thus possible to delimit accurately the altitudinal ranges of the seven species occurring on Benom.

Of five species of barbets found near Base camp, the Gaudy Barbet *Megalaima mystacophanos* had the most limited range, extending no higher than 1700 ft. The Brown Barbet *Calorhamphus fuliginosus* was noted up to 2400 ft; the Yellow-crowned Barbet *M. henricii* up to 2600 ft; the Blue-eared Barbet *M. australis* up to 2800 ft; and the Golden-whiskered Barbet *M. chrysopogon* up to 3400 ft. Of the montane group, the first to be heard on the ascent was Müller's Barbet *M.*

oorti which ranged from 2500–4000 ft, being most abundant at 3000–3500 ft. The Fire-tufted Barbet *Psilopogon pyrolophus* was recorded from 3500–6000 ft, and in a short middle section of its range was the only barbet present, between the upper limit of Müller's Barbet and the lower limit of the Golden-throated Barbet *M. franklinii* at 4400 ft. The latter extended to the summit ridge. *M. franklinii* has previously been reported from Benom (Chasen & Kloss, 1928) although the record was overlooked by Gibson-Hill (1949).

Indicatoridae

One specimen of the rare Malay Honeyguide *Indicator archipelagicus* was collected at 900 ft (cf. Medway, Nisbet & Wells, 1968).

Picidae

Woodpeckers were fairly often seen or heard at moderate and low altitudes but few were collected and visual identification was not always possible. For species recorded only once the full altitudinal range clearly remains undetermined; further experience might also be expected to add to the list. The Rufous Piculet *Sasia abnormis* was netted at 700 and 2500 ft, and the Buff-necked Woodpecker *Meiglyptes tukki* at 700 and 3600 ft; both are assumed to occur also at intervening elevations. Three lowland species were recorded more frequently: the Crimson-winged Woodpecker *Picus puniceus*, from 900–1700 ft; the Maroon Woodpecker *Blythipicus rubiginosus* from 700–3300 ft; and the Orange-backed Woodpecker *Chrysocolaptes validus* from 900–2400 ft. The following were recorded once only: the Grey-and-buff Woodpecker *Hemicircus concretus* at 700 ft; the Fulvous-rumped Woodpecker *Meiglyptes tristis* at 1700 ft; the Checker-throated Woodpecker *Picus mentalis* at 3600 ft; and the Bay Woodpecker *Blythipicus pyrrhotis* at 4900 ft, providing the first record of this species east of the Main Range (cf. Medway, Nisbet & Wells, 1968). In the montane zone, the Lesser Yellow-naped Woodpecker *Picus chlorolophus* was seen and collected at 4700–6000 ft; unconfirmed sightings at 3500 ft were tentatively attributed to this woodpecker, which again has not previously been recorded east of the Main Range (Gibson-Hill, 1949).

Eurylaimidae

Four broadbills were recorded, all at lowland elevations. One Black-and-red Broadbill *Cymbirhynchus macrorhynchos* was collected at 700 ft. The Banded Broadbill *Eurylaimus javanicus* was nesting in the tall tualang tree (*Koompassia excelsa*) at Base camp and was recorded up to 1600 ft, and the Black-and-yellow Broadbill *E. ochromalus* from 600–2300 ft. The less conspicuous Green Broadbill *Calyptomena viridis* was netted at 700, 1700 and 2500 ft.

Pittidae

One Giant Pitta *Pitta caerulea* was caught by night roosting in undergrowth at 800 ft, and one Hooded Pitta *P. sordida* was collected at 700 ft; the latter is a migratory visitor at the latitudes of Benom.

Hirundinidae

Swallows were regularly present, feeding above the canopy at all elevations from Base camp to the summit, but few positive identifications were made and the records have been omitted from Table 1. Only the migratory Barn Swallow *Hirundo rustica* was seen at the summit itself on 27 March 1967, but the resident Pacific Swallow *H. tahitica* was identified at Base camp and probably ranged higher. The damaged carcase of an Asiatic Martin *Delichon dasypus*, perhaps struck and dropped by a raptor, was picked up at 1700 ft on 15 February 1968.

Motacillidae

One Grey Wagtail *Motacilla caspica* was seen on the logging track near Base camp, 2 February 1967. The species is ecologically limited to openings in the forest habitat, and has been omitted from Table 1.

Campephagidae

The Black-faced Cuckoo-shrike *Coracina novaehollandiae* was relatively common and conspicuous from camp 3 to 5800 ft; there are no previous published records from Benom. In the lowlands, single sight records were obtained of the Lesser Cuckoo-shrike *C. fimbriata* at 1600 ft; the Black-winged Flycatcher-shrike *Hemipus hirundinaceus* at 900 ft; and the Bar-winged Flycatcher-shrike *H. picatus* at 1700 ft. Both the Fiery Minivet *Pericrocotus cinnamomeus* and the Scarlet *P. flammeus* were recorded from 700–1700 ft. The Mountain Minivet *P. solaris* was common from 3200 ft to the summit ridge above 6800 ft. Between 1700 and 3200 ft no minivets were recorded. Although further work is likely to reduce this gap there was thus no evidence of overlap between the lowland and highland species.

Aegithinidae

The Great Iora *Aegithina lafresnayei* was seen once at 700 ft. The Lesser Green Leafbird *Chloropsis cyanopogon* was recorded from 700–1700 ft; the Greater, *C. sonnerati*, once only at 900 ft; the Blue-winged Leafbird *C. cochinchinensis* over a wide altitudinal range from 700–3500 ft, and the Orange-bellied Leafbird *C. hardwickii* from 4300–4900 ft. *C. hardwickii* has not previously been reported east of the Main Range. The Fairy Bluebird *Irena puella* was common from 700–1700 ft.

Pycnonotidae

The bulbuls were well represented on Benom, common and conspicuous at most elevations. Our observations indicate a clear pattern of altitudinal zonation within the family. Of 10 species recorded below 900 ft, none were observed above 2600 ft: the Scaly-breated Bulbul *Pycnonotus squamatus* 700–1300 ft; the Grey-bellied *P. cyaniventris* 700–1800 ft; the Red-eyed Bulbul *P. brunneus*, 700–1400 ft; the White-eyed Bulbul *P. simplex*, 700–2400 ft; the Lesser Brown Bulbul *P. erythropthalmos*, 700–2500 ft; the Scrub Bulbul *Criniger bres*, 700–1800 ft; the Yellow-bellied Bulbul *C. phaeocephalus*, 700–2500 ft; Finsch's Bulbul *C. finschii*, 900–1400 ft; and the

Hairy-backed Bulbul *Hypsipetes criniger* 700–2600 ft. Two species were confined to a restricted upper lowland zone: the Crested Olive Bulbul *Hypsipetes charlottae*, below camp 2 at 1400–1700 ft where it was common, and the Streaked Bulbul *H. viridescens* (c.q. *H. malaccensis*) 1300–2400 ft. Two species had a distinctive submontane distribution: the Ashy Bulbul *H. flavala*, 1400–3600 ft, and the Ochraceous Bulbul *Criniger ochraceus*, 2500–3600 ft. The single montane species, the Mountain Streaked Bulbul *Hypsipetes macclellandii*, extended from 3500 ft to the summit ridge. The Black-and-white Bulbul *Pycnonotus melanoleucos*, previously collected at 6000 ft on Benom (Robinson, 1928), was not recorded during our expedition and has been omitted from Table 1.

Dicruridae

Two resident drongos were recorded, the Greater Racket-tailed Drongo *Dicrurus paradiseus* near Base camp at 700 ft, and the Lesser Racket-tailed Drongo *D. remifer* over a wide altitudinal range from 1600 ft, below camp 2 where birds were seen many times in February 1968, to 6000 ft. The Crow-billed Drongo *D. annectans*, one of the relatively few migratory birds of the understorey of the forest, was recorded from 1000–1800 ft in February and early March.

Oriolidae

At low elevations the Dark-throated Oriole *Oriolus xanthonotus*, was recorded at 700–800 ft, and at higher elevations the Black-and-crimson Oriole *O. cruentus* at 3100–4200 ft.

Corvidae

The Crested Jay *Platylophus galericulatus* was seen in heavily logged forest at 500 ft on the track from Base camp to Ulu Cheka, and was netted at 2500 ft. A crow collected at Base camp is identified from measurements as the rare Slender-billed Crow *Corvus enca*; a sight record at camp 2, of a single bird uttering a high-pitched caw (D. R. Wells) is also attributed to this species.

Paridae

The Sultan Tit *Melanochlora sultanea* occurred over a wide range from 700–3900 ft.

Sittidae

The Velvet-fronted Nuthatch *Sitta frontalis* was seen at 1000 and 1700 ft. The Blue Nuthatch *S. azurea*, prevously recorded from Benom by Robinson (1928), was seen once only at 5000 ft.

Timaliidae

The babblers were well represented and formed a major part of the avifauna at all elevations. Zonation was marked, with every species restricted to a limited altitudinal zone varying in range from 4000 to a few hundred feet. Seven lowland species were found only in the neighbourhood of Base camp, which may have been near the upper limit of their range: the Black-capped Babbler *Pellorneum capistratum*, Horsfield's Babbler *Trichastoma sepiarium*, the Ferruginous Babbler *T. bicolor*, the Sooty-headed Babbler *Malacopteron affine*, the Striped Wren Babbler *Kenopia striata*, the Large Wren Babbler *Napothera macrodactyla*, and the Fluffy-backed Tit Babbler *Macronus ptilosus*. Eleven others also occurring at Base camp were more widely distributed, extending to higher elevations as follows: the Short-tailed Babbler *Trichastoma malaccense*, netted at 700, 1700 and 2600 ft; the Greater Red-headed Babbler *Malacopteron magnum*, netted at 700 and 1700 ft; the Lesser Red-headed Babbler *M. cinereum*, netted at 700, 1700 and 2600 ft; the Moustached Babbler *M. magnirostre*, 700–2600 ft; the Striped Tit Babbler *Macronus gularis*, identified by its distinctive call from 700–2300 ft; the Grey-throated Babbler *Stachyris nigriceps*, 700–3600 ft; the Grey-headed Babbler *S. poliocephala*, 700–1700 ft; the White-eared Babbler *S. leucotis*, 700–2600 ft; the Red-rumped Babbler *S. maculata*, 700–1700 ft; the Red-winged Babbler *S. erythroptera*, 700–2600 ft; and the Brown Nun Babbler *Alcippe brunneicauda*, 700–2600 ft. At intermediate elevations two species were recorded in the submontane zone: the Chestnut-backed Scimitar Babbler *Pomatorhinus montanus*, 1700–2600 ft and the Small Wren Babbler *Napothera epilepidota*, from 2300 ft where a nest with downy young was found on 16 February 1968, to 3300 ft. Three others recorded at medium elevations on Benom have wider ranges elsewhere: the Marbled Wren Babbler *N. loricata* netted at 2500 ft; the Black-necked Babbler *Stachyris nigricollis*, netted at 1700 ft, and the White-bellied Yuhina *Yuhina zantholeuca*, seen from 1600–3500 ft.

In the montane zone, the Mountain Nun Babbler *Alcippe peracensis* ranged most widely, from 2600 ft where one bird was netted (establishing overlap with the lowland *A. brunneicauda*) to 6000 ft. The related but ecologically distinct Chestnut-headed Nun Babbler, *A. castaneceps*, was recorded from 3500–6000 ft. (Table 2). The three laughing thrushes also overlapped in distribution, with the rare Black Laughing Thrush *Garrulax lugubris* (not previously recorded east of the Main Range) collected at 3600 ft and seen again at 4200 ft, the Chestnut-capped Laughing Thrush *G. mitratus* recorded from 3600–5400 ft, and the Red-headed Laughing Thrush *G. erythrocephalus* from 4400 ft to the summit ridge at 6600 ft. Other birds of the lower montane zone comprised the Large Scimitar Babbler *Pomatorhinus hypoleucos* recorded from 3600 ft and ranging to the summit ridge; the Streaked Wren Babbler *Napothera brevicaudata*, the Pygmy Wren Babbler *Microura pusilla* and the Golden-headed Babbler *Stachyris chrysea*, all from 3500–6000 ft; and the Red-winged Shrike Babbler *Pteruthius flaviscapis* from 3500–5300 ft. The last named overlapped in range with the smaller, ecologically separated Chestnut-throated Shrike Babbler *P. melanotis*, recorded only at upper montane elevations from 4900–6000 ft. Also members of the upper montane fauna were the Cutia *Cutia nipalensis*, recorded from 4900–6400 ft, and the Chestnut-tailed Siva *Minla strigula*, 5200–6800 ft. Records of the Long-tailed Sibia *Heterophasia picaoides*, a noisy and conspicuous babbler, were also confined to upper montaine elevations, 4900–6500 ft, with the exception of a single bird seen at 1900 ft on 2 February 1968; this anomalous record is presumed to represent a straggler, and intervening elevations have not been included in the normal range of the species (Table 1).

Turdidae

The migratory Siberian Blue Robin *Erithacus cyane* was common in the understorey of the forest from 700–2600 ft. The latest record was a male netted on 12 April 1967, within the species' normal wintering period in Malaya (Wells, 1969). The White-rumped Shama *Copsychus malabaricus* was recorded from 700–1700 ft, where it overlapped with the Orange-tailed Shama *C. pyrropyga*, recorded from 1700–2600 ft. Along stream sides, the White-crowned Forktail *Enicurus leschenaulti* was netted only near Base camp, and the Chestnut-naped Forktail, *E. ruficapillus* at 700 and 1700 ft. In addition, an unidentified forktail was seen at 2500 ft and the distinctive thin whistle of the genus was heard at 3500 ft.

Sylviidae

Identified by its distinctive call, the Flyeater *Gerygone fusca* was recorded from 700–3200 ft. In the lower montane zone, the Chestnut-crowned Flycatcher Warbler *Seicercus castaniceps* was seen at 3500–3600 ft; this is the first record of the species east of the Main Range. At higher elevations, the Yellow-breasted Flycatcher Warbler *S. montis* was recorded from 5300–6300 ft, and the Mountain Leaf Warbler *Phylloscopus trivirgatus* from 5700–6000 ft. In both years migratory leaf warblers, *Phylloscopus* spp., were common at low to moderate elevations, feeding largely at canopy level where they were easily recognized but difficult to identify to species. The Eastern Crowned Leaf Warbler *P. coronatus* was recorded from 700–4200 ft; the Arctic Warbler *P. borealis* was positively identified only at 2700 ft but certainly has a wider range, possibly coterminous with *P. coronatus*. Near Base camp, the Red-tailed Tailorbird *Orthotomus sericeus* was found only along the track-side, nesting in the young secondary growth. The Black-necked Tailorbird *O. atrogularis* was also recorded in disturbed vegetation from 1300–1700 ft. The Mountain tailorbird *O. cuculatus* was common in virgin habitat from 4200 ft to the summit ridge at 6800 ft.

Muscicapidae

Migratory flycatchers were recorded only at lower elevations: the Brown Flycatcher *Muscicapa latirostris*, at 900–2400 ft; the Sooty Flycatcher *M. sibirica* and the Ferruginous Flycatcher *M. ferruginea*, at 1700 ft; and the Blue-throated Flycatcher *M. rubeculoides* at 700–1700 ft. Resident species recorded in this zone were the Pearl-spotted Fantail *Rhipudura perlata*, from 700–2500 ft; the Grey-headed Flycatcher *Culicicapa ceylonensis*, present over a wide altitudinal range from 700–4200 ft; the Orange-breasted Flycatcher *M. dumetoria*, netted at 700 ft; the Pale Blue Flycatcher *M. unicolor*, seen at 1500 ft; the White-throated Jungle

Flycatcher *Rhinomyias umbratilis*, from 1400–2600 ft; the Chestnut-winged Monarch *Philentoma pyrhoptera*, the Maroon-breasted Monarch *P. velatum* and the Black-naped Monarch *Hypothymis azurea*, all from 700–2500 ft; and the Paradise Flycatcher *Terpsiphone paradisi*, 1300 and 2500 ft. At higher elevations the White-throated Fantail *Rhipidura albicollis* was recorded from 3400–6800 ft. The White-throated Flycatcher *Muscicapa solitaris* was netted at 3600 ft, the first record of the species from Benom. Other resident flycatchers were common and widespread in the montane zone: the Great Niltava *Muscicapa grandis*, 4000–6000 ft; the White-fronted Flycatcher *M. hyperythra*, 4700–6700 ft; the Little Pied Flycatcher *M. westermanni*, 3800–6000 ft, and the Pygmy Blue Flycatcher *Muscicapa hodgsoni*, 3500–6000 ft.

Nectariniidae

Near Base camp the Little Spiderhunter *Arachnothera longirostris* was netted in greater numbers than any other bird (Table 2). The local abundance of this long-billed nectarivore was undoubtedly related to the proliferation of wild banana plants, many in flower, along the tracks and in other areas disturbed by recent logging operations; however its full altitudinal range from 700–3600 ft extended into virgin forest near camp 3. The Grey-breasted Spiderhunter *A. affinis* was recorded from 700–1700 ft, and the Purple-naped Sunbird *Hypogramma hypogrammicum* from 700–3800 ft. A male Scarlet Sunbird *Aethopyga mystacalis* was seen at 700 ft, and the Plain Sunbird *Anthreptes simplex* and the Ruby-cheeked Sunbird *A. singalensis* were both recorded at 1700 ft. The Long-billed Spiderhunter *Arachnothera robusta* was seen at 1400 ft, and an unidentified yellow-cheeked spiderhunter at 800 ft. At higher elevations, the Black-throated Sunbird *Aethopyga saturata* was recorded from 3500–6700 ft, and the Streaked Spiderhunter *Arachnothera magna* from 3600–5000 ft.

Dicaeidae

The Orange-bellied Flowerpecker *Dicaeum trigonostigma* was recorded only at 700 ft, but the Yellow-throated Flowerpecker *Prionochilus maculatus* was seen and netted from 700–3500 ft. At higher elevations the Fire-breasted Flowerpecker *Dicaeum ignipectus*, not previously recorded from Benom, was seen from 3500–5700 ft. One Thick-billed-Flowerpecker *D. agile* (=*Piprisoma modestum* in Gibson-Hill, 1949; cf. Salomonsen, 1960) seen at 4200 ft (I. C. T. Nisbet) constitutes a new locality record for this rare bird.

Zosteropidae

White-eyes seen from 1600–3600 ft are attributed to *Zosterops everetti*.

Fringillidae

The Brown Bullfinch *Pyrrhula nipalensis* was common from 5000–6100 ft.

2. Mammals

It is unlikely that there are major seasonal changes in altitudinal zonation among the terrestrial mammals of the Malaysian forest, with the possible exception of some bats. The commoner rats have been shown to be permanently resident within small ranges throughout their lifetimes (Harrison, 1958). Work on rats and other small mammals in Selangor has found no limited breeding season, although some species show seasonal peaks in reproductive activity (Harrison, 1955; Medway, 1967). The evidence of autopsied specimens from Benom (Appendix 2) shows that a large proportion of females collected were pregnant or lactating at the time of the expedition.

Middle-sized mammals including siamang (Chivers, 1971), gibbons (Ellefson, 1968), leaf-monkeys (Furaya, 1962; Bernstein, 1968), macaques (Bernstein, 1967) and mouse-deer (unpublished), either as small family groups or large gregarious troops, also reside permanently within the bounds of restricted territories or home-ranges. Among the bigger ungulates, elephant (Mohamed Khan, 1967), rhinoceros (Strickland, 1966) and gaur (Hubback, 1937; Weigum, 1970) have also been shown to forage within the limits of large but circumscribed ranges.

Among the bats, no Malayan species is known to be migratory, although several —including members of the families Pteropodidae, Rhinolophidae and Vespertilionidae—make long flights in search of food, while others shift roosting sites irregularly or at certain stages of the reproductive cycle (cf. Medway, 1969). Autopsy records summarized in Appendix 2 show that the majority of females of most species of bats taken during the expedition were pregnant or lactating. As among birds, it is likely that the selective effect of factors controlling altitudinal zonation is strongest at the time of production of young. Although fruit bats were trapped in standing mist-nets left untended during the night, all rhinolophids and vespertilionids were netted at dusk shortly after emergence, and must have been close to their roosts; the single emballonurid species was taken actually at its roost sites.

In contrast to birds, among which sight records and call identifications form a major proportion of the observations summarized above, most small mammals (except the diurnal squirrels) are inconspicuous, often nocturnal or difficult to see by day. The majority of records given below are therefore based on specimens collected, and in many cases fail to indicate the species' full altitudinal range. Except for readily caught and common diurnal squirrels and ground-living rats, even trapping results are deficient. The 'Longworth' traps caught only one small rat, *Rattus whiteheadi*, in a total of 1500 trap nights, and are evidently unsuitable in this environment. With the exception of the shrews *Crocidura fuliginosa* and *Suncus etruscus*, which may be very rare in virgin forest, there are few mammals in the Malaysian rainforest small enough to enter this type of trap. Even the standard cage traps were relatively unsuccessful. The overall rate of catch, at 2·0 per 100 trap nights was low (Table 3, cf. Harrison's figure of 5·0/100 trap nights from Selangor forests, given by Medway, 1966). Of 20 species trapped, five (25 per cent) were taken only once and not recorded by any other means; their full altitudinal range is certainly greater than indicated.

Systematic section

See Table 4 for diagrammatic summaries of distribution.

Erinaceidae

The Moonrat or Gymnure *Echinosorex gymnurus* was trapped once near Base camp; this species is characteristically present only at low density in lowland forest (Harrison, 1969).

Soricidae

A shrew, presumably the South-east Asian White-toothed Shrew *Crocidura fuliginosa*, was seen at camp 4 but not caught.

Cynocephalidae

The nocturnal Flying Lemur or Colugo *Cynocephalus variegatus* was collected only near Base camp.

Pteropodidae

All fruit bats were netted and records are therefore confined to the areas near each camp in which nets were set. Three Malaysian Fruit Bats *Cynopterus brachyotis* were taken at Base camp and camp 2 only. The Dusky Fruit Bat *Penthetor lucasi* was netted once, at Camp 3. This species is an obligatory cavernicole and its distribution is presumably limited by the occurrence of suitable caves or rock shelters in which it can roost; as already noted (Medway, 1972), such sites are abundant at higher altitudes on Benom. Four Spotted-winged Fruit Bats *Balionycteris maculata* were taken, at Base camp and camp 2. Two Tailless Fruit Bats *Megaerops ecaudatus* and two Hill Long-tongued Fruit Bats *Macroglossus minimus* were netted near Base camp; both species have a wider altitudinal range elsewhere in Malaya (Medway, 1969). The Black-capped Fruit Bat *Chironax melanocephalus* was taken from 900–5000 ft, most specimens at 3500 ft and upwards. The Grey Fruit Bat *Aethalops alecto* was taken only at 6000 ft on the ridge above camp 5; the species has not previously been recorded east of the Main Range in Malaya (Hill, 1961).

Emballonuridae

Small groups of Sheath-tailed Bats *Emballonura monticola* were found at roost under the trunks of fallen trees at 900 and 1600 ft.

Rhinolophidae

At Base camp and camps 2 and 2½, the three horseshoe bats *Rhinolophus affinis*, *R. stheno* and *R. refulgens* were netted in large numbers at nightfall from mixed flight streams winding through the forest a few feet above ground; no roosting sites could be found. Both sexes were represented in the samples in approximately equal numbers; most females were pregnant (Appendix 2) but evidently not segregated in maternity colonies. *Rhinolophus macrotis* was also taken at Base camp, but was proportionally more abundant at 2500 and 3500 ft; the species had not previously been recorded from Malaya (Hill, 1972).

The Trefoil Horseshoe Bat *Rhinolophus trifoliatus* and the three roundleaf horseshoe bats *Hipposideros bicolor, H. galeritus* and *H. diadema* were netted only near Base camp.

Vespertilionidae

Single specimens of the rare *Pipistrellus ridleyi* and the new species *P. societatis* (Hill, 1972) were netted in tall forest under a closed canopy near Base Camp. *P. javanicus* was taken near camp 2; elsewhere this pipistrelle has been found in the settled lowlands, and in a few towns it is locally common (Medway, 1969). Of the tube-nosed bats, *Murina cyclotis* was netted near Base camp and *M. huttoni* at 4800 ft; the latter had not previously been found in Malaya (Hill, 1972). The Papillose Bat *Kerivoula papillosa* was taken at 1700 and 2500 ft.

Tupaiidae

One Lesser Treeshrew *Tupaia minor* was trapped at 800 ft, and one Pentail Treeshrew *Ptilocercus lowii* shot at 1700 ft. The Common Treeshrew *Tupaia glis* was seen from 900–3000 ft, although collected only at 1700 ft (B. L. Lim).

Lorisidae

One Slow Loris *Nycticebus coucang* was collected at 800 ft.

Cercopithecidae

The commonest monkey at lower elevations was the Dusky Leaf-monkey *Presbytis obscura*, seen and collected from 700–2800 ft. The Banded Leaf-monkey *P. melalophos* was also present at these altitudes, and extended up to the final slopes of the summit where a large troop was disturbed at midday at 6500 ft. During the expedition, the Long-tailed Macaque *Macaca fascicularis* was recorded only at 700 ft; a sight record above 4000 ft on Benom has since been reported to me, but is not included in Table 2. Similarly, during the expedition Pig-tailed Macaques *M. nemestrina* were found only at 2400 and 3600 ft, but elsewhere the altitudinal range of the species is greater and includes lowland forest (Bernstein, 1967).

Hylobatidae

The Lar Gibbon *Hylobates lar* was seen or heard from Base camp to 4700 ft and the Siamang *Hylobates syndactylus* over a wider range, up to the saddle between camp 5 and the summit ridge, at 6000 ft. Both species evidently exploit a broad variety of forest types, and are not restricted to the lowland formations dominated by dipterocarps.

Manidae

The Pangolin *Manis javanica* was collected once near Base camp.

Sciuridae

Apart from the large primates and several ungulates, the Slender Squirrel *Sundasciurus tenuis* is the only mammal common both at Base camp and up to 6000 ft on the summit ridge. On Gunong Tahan a high-level subspecies, *S. tenuis tahan* (Bonhote), has been distinguished; examination of the material from Benom suggests that no parallel local subspeciation has occurred. Although no records of this squirrel were obtained between 1900 and 4400 ft, it is assumed that it occurs continuously through the full altitudinal range.

All other typical (diurnal) squirrels exhibit marked altitudinal zonation. The Golden-backed Squirrel *Callosciurus caniceps* was collected only once, below Base camp. The species is ecologically restricted to disturbed forest, secondary growth and plantation, and therefore excluded from the virgin forest higher on Benom; in other localities however, where ecological conditions permit, it has been found at greater altitudes (Medway, 1969). Of the squirrels inhabiting undisturbed forest, the following were recorded at low altitudes only: the Plantain Squirrel *Callosciurus notatus* and the Black-banded Squirrel *C. nigrovittatus* from 700–1100 ft; Prevost's Squirrel *C. prevostii* at 1700 ft; the Horse-tailed Squirrel *Sundasciurus hippurus* collected at 800 ft; Low's Squirrel *S. lowii* from 800–1200 ft; the Three-striped Ground Squirrel *Lariscus insignis* from 700–1200 ft, and the Shrew-faced Ground Squirrel *Rhinosciurus laticaudatus* at 700–800 ft only. There was a distinct gap between the upper records of this lowland group and the lower limits of the two highland species, the Belly-banded Squirrel *Callosciurus flavimanus* at 4000 ft and the Himalayan Striped Squirrel *Tamiops macclellandii* at 3600 ft. Both *C. flavimanus* and *T. macclellandii* were common and conspicuous within their range, extending to at least 6000 ft.

Of the flying squirrels, the Red-cheeked Flying Squirrel *Hylopetes spadiceus* and the Smoky Flying Squirrel *Pteromyscus pulverulentus* were collected at 1700 ft; Horsfield's Flying Squirrel *Iomys horsfieldii* was trapped several times at 800 ft near Base camp where it was evidently common, and once caught in a mist-net at 5100 ft. The Black Flying Squirrel *Aeromys tephromelas* was collected at 700 and 2500 ft; the Red Giant Flying Squirrel *Petaurista petaurista* was common from 700–1500 ft; and the Spotted Flying Squirrel *P. elegans* was collected only at 700–800 ft. Elsewhere *P. elegans* has an extensive high altitude range (Harrison, 1964; Medway, 1969). Further collecting may find it higher on Benom, but the present records emphasize that the species is not the montane ecological counterpart of *P. petaurista*.

Muridae

The small arboreal mouse *Chiropodomys gliroides* was seen at Base camp and collected at 1700 ft (B. L. Lim). Of the true rats, genus *Rattus*, Mueller's Rat *R. muelleri* and Bowers's Rat *R. bowersii* were trapped only near Base camp (Table 3). Elsewhere the latter in particular has a more extensive altitudinal range. Both species, however, are ecologically restricted to valley bottoms (cf. Harrison, 1957), a habitat that was adequately sampled only below 1000 ft. At higher elevations all traps were set on the crest or flanks of the north-east ridge, from which *R. muelleri* and *R. bowersii* would be ecologically excluded. The Dark-tailed Tree Rat *R. cremoriventer* was also trapped only near Base camp. The commonest rat at lowland elevations was the Long-tailed Giant Rat *R. sabanus* (cf. Table 3), which was trapped from 700–2900 ft. Whitehead's Rat *R. whiteheadi* and the Brown Spiny Rat *R. rajah* were both trapped from the vicinity of Base camp up to 2500 ft. The Red Spiny Rat *R. surifer* was trapped once only, at 2500 ft, and was greatly outnumbered in the catch by its sibling species *R. rajah* (Table 3); the affinity of these rats is discussed below by Yong (1969, 1972). Near camp 3, we trapped one young adult female Malaysian Wood Rat *R. tiomanicus*, a species which on the Malayan mainland is semi-commensal in habit and characteristically found in disturbed or fringing forest, secondary growth and plantation. Island populations of this rat occupy a wider variety of habitats (Medway, 1966), and the occurrence of this specimen here on Benom indicates that on the mainland, too, virgin forest is not a complete barrier to the dispersal of the species.

With this exception, no overlap in range was found between the lowland rats and the two highland species, the Malayan Mountain Spiny Rat *R. inas* and Edwards's Giant Rat *R. edwardsi*, neither of which was trapped below 3500 ft. Both occurred up to at least 6000 ft (Table 3).

Hystricidae

Spines of the Brush-tailed Porcupine *Atherurus macrourus* were found in the dung of a large carnivore (tiger or leopard) at 1900 ft. There were no other records of porcupines.

Ursidae

Tracks or other traces of the Malay Sun Bear *Helarctos malayanus* were found from near Base camp up to 2400 ft; a single bear was seen 1600 ft (R. Garcia).

Viverridae

A Banded Linsang *Prionodom linsang* was caught in a ground snare at 3500 ft. A Binturong *Arctictis binturong* was collected at 700 ft and a Banded Palm Civet *Hemigalus derbyanus* at 800 ft. Slightly more common near Base camp was the Three-striped Palm Civet *Arctogalidia trivirgata*, shot and seen from 900–1200 ft.

Felidae

The Leopard Cat *Felis bengalensis* was recorded several times near Base camp only. The Tiger *Panthera tigris* and Leopard *P. pardus* were positively identified from tracks only near Base camp, but indistinct tracks and the dung of large felids were found at several points up to 5500 ft.

Elephantidae

Tracks and other signs of the Indian Elephant *Elaphas maximus* were numerous in the valley by and below Base camp, but there was no sign that they went any higher.

Tapiridae

The entire length of the path from Base camp virtually to the summit was marked with old and fresh tracks and dung of the Malay Tapir *Tapirus indicus*. At no point was there evidence of more than one animal passing at a time, and all traces were compatible with the presence of a single adult tapir ranging very widely on the mountainside.

Suidae

Pig tracks were found from 700–5300 ft, but no animals were seen. The species is likely to be the common Wild Pig, *Sus scrofa*, which has been collected in the southeast sector of the Kerau Game Reserve (Hoogstraal *et al.*, 1972). There are however, unconfirmed reports of the Bearded Pig *S. barbatus* from Kuala Tahan, Sungei Tembiling, north of Benom in the Pahang drainage (Medway, 1963), and without specimens the tracks alone cannot distinguish between the two species.

Tragulidae

The Lesser Mouse-deer *Tragulus javanicus* was collected near Base camp, where tracks were also identified, and seen once at 6000 ft (B. Hamid).

Cervidae

The Barking Deer *Muntiacus muntjak* was identified from tracks near Base camp. Elsewhere this deer has been shown to have a wide altitudinal range (Medway, 1969).

Bovidae

A Serow *Capricornis sumatraensis* was seen in the stream bed at Base camp, and tracks were identified at 2600 ft. In general the Serow frequents steep, damp gullies in the Malayan hills, and may be ecologically excluded from the high ridges that the expedition followed.

DISCUSSION

1. The lowland fauna

Of 191 species of birds identified in the forest on Gunong Benom, 141 species

(74 per cent of the total) were recorded at altitudes below 2500 ft (Table 1), and of 81 species of mammals, 69 (85 per cent) were recorded within this range (Table 4).

For both classes, the composition of the lowland fauna is similar to assemblages of species from forest at comparable altitudes in Selangor, on the western side of the Main Ridge, e.g. the birds of Ampang Forest Reserve (Medway & Wells, 1963; K. W. Scriven, unpublished), or Ulu Gombak Forest Reserve (Medway & Wells, 1964; McClure, 1966, 1967; Medway, unpublished), and the mammals of Sungei Buloh Forest Reserve (Harrison, 1969). Evidently the Main Range, with several passes lower than 2500 ft at its southern end, does not form a barrier to the distribution of lowland birds or mammals in this region.

Even within the lowlands below 2500 ft, progressive attenuation of the fauna is observed in both classes. Thirty species of birds and 29 mammals were recorded only below 1000 ft. A few of these (e.g., the rodents *Callosciurus caniceps* and *Rattus muelleri*) are known to be ecologically restricted to habitats that did not occur or were not sampled above this altitude; others were difficult to collect or observe, or rare or widely dispersed species, poorly represented in our sample and likely to occur in fact over a greater altitudinal range. But, particularly among the birds for which data are more comprehensive, a proportion of these restricted lowland species must have been near the natural upper limit of their range at the altitude of Base camp.

The progressive reduction in the number of species with altitude even within the lowland range is shown in Tables 5 and 6, in which it is seen that 109 birds and 62 mammals were recorded below 1000 ft, 112 birds and 40 mammals between 1000–1900 ft, and only 70 birds and 25 mammals in the range 2000–2900 ft.

Beyond 2500 ft, upward extension of both lowland faunas is limited. The effect is again more marked among birds of which only 24 lowland species reached 3000 ft and only four were recorded at 4000 ft; only one forest bird, the cuckoo-dove *Macropygia ruficeps*, extended over the entire altitudinal range explored, from 700 ft to the summit ridges above 6000 ft. Among mammals only 15 lowland species reached 3000 ft, but of these nine extended to 4000 ft or above and effectively had no altitudinal limits.

It is of interest to note that the lowland fauna included all migrant birds, although there is variation in the altitudinal limits of each species. The commoner species for which reliable data were obtained included the flycatcher *Muscicapa rubeculoides* (700–1700 ft), the robin *Erithacus cyane* (700–2600 ft) and the leaf warbler *Phylloscopus coronatus* (700–4200 ft). Several *E. cyane*, ringed and later retrapped in the same area, were clearly sedentary in their winter quarters, and repeated sight records of *Muscicapa latirostris* and *M. sibirica* at distinctive perches indicated that these flycatchers, too, were sedentary. All migratory passerines recorded on Benom have been trapped during their migration at much higher elevations (cf. Medway, Nisbet & Wells, 1968; Nisbet, 1968). Evidently they do not remain at these heights, but disperse to winter in the forest at lower elevations.

The catch of birds in mist-nets gives an indication of the number of species active in the undergrowth and lower storey of the forest, and therefore susceptible to this method of trapping. At lowland elevations (below 2000 ft), 55 species were netted, representing 39 per cent of the total number recorded. Some ground-living birds (e.g. gallinaceous birds, and the pittas) may be too large or too wary to be netted; a few others within this vertical zone may be too small to have been held in the mesh of the net. Field observations, however, support the indication that about three-fifths of the lowland avifauna is active in the middle and upper storeys of the forest, above the level of the mist-nets.

In a normal ringing survey, in which birds are not abstracted from the population, netting results also serve as a guide to the comparative abundance of birds in the forest undergrowth. Since a large proportion of the birds netted on Benom were killed for museum specimens, figures obtained are not comparable. Despite this, the average numbers of birds/net/day below 2000 ft (Table 2) are higher than the catches in lowland forest at Subang, Selangor, which varied from 0·83 to 0·46 during the course of the year (McClure & Othman, 1965). The high catch near Base camp on Benom is attributable to the large numbers of Little Spiderhunters netted (Table 2); if these are excluded the mean number of birds/net/day is 1·0.

2. The highland fauna

As shown above, only a very small proportion (3 per cent) of the lowland birds reach 4000 ft, and the avifauna of the upper 2000 ft of the mountain is very distinct. Only 48 species were found above 4000 ft, of which 39 reach 5000 ft and 31 reach 6000 ft (Table 5). Compared with the highland avifauna of the Main Range, the list of species from Benom is slightly impoverished. The following montane birds are relatively common and conspicuous at Fraser's Hill on the Main Range, and are unlikely to have been missed if present on Benom; those marked * are recorded from Gunong Tahan (Ogilvy-Grant, 1908; Gibson-Hill, 1949): *Picus flavinucha, Kitta chinensis**, *Trichastoma tickelli, Leiothrix argentaurus**, *Minla cyanouroptera, Myiomela leucura* and *Brachypteryx leucophrys*. Also absent is *Prinia atrogularis*, known in Malaya only from Gunong Tahan where it is common in the stunted, open vegetation of the high plateaux.

Among mammals, also, the highland fauna above 4000 ft was impoverished. But many larger species ranged from the lowlands high into the montane zone, and only four small rodents were restricted to altitudes above 3500 ft. Again two conspicuous mammals, common at Fraser's Hill, are unlikely to have been missed if present on Benom: *Hylomys suillus, Dremomys rufigenis*. Only the latter is found on Gunong Tahan (Bonhote, 1908).

The faunal differences between Benom and Tahan indicate that each mountain was independently colonized from a different source by a slightly different community of montane birds and mammals. The area of high ground on Benom is relatively extensive, estimated as 75 square miles above 3000 ft (Medway, 1972). Unless the local extinction of montane species has occurred in recent times, the narrow strip of lowlands *ca.* 20 miles wide has evidently been a partial barrier to the distribution of specialized high altitude forms from the Main Range.

In the upper 2000 ft of the mountain, near camps 5 and 6, 22 species of forest birds were taken in mist nets out of a total fauna of 41 species (53 per cent). The increased proportion of the avifauna susceptible to netting can be correlated with the reduced height of the forest at these altitudes (Whitmore, 1972), and consequent limitation on vertical separation of bird species. The overall rate of trapping, as birds/net/day, was lower than at Base camp and camp 2, but not below the mean figure for lowland forests at Subang, Selangor (McClure & Othman, 1965).

Among birds, the high ridges above 6000 ft are occupied merely by a depleted selection of the species present at 5000 ft, and there is no evidence of a distinct summit fauna. Among mammals, however, the fruit bat *Aethalops alecto* was found only in this zone, to which it is apparently specialized (Hill, 1961).

3. The intermediate fauna

Most birds recorded between 2000–3900 ft are clearly distributed mainly in the highlands or mainly in the lowlands (Table 1). The transition between two zones occurs relatively abruptly between 2500 and 3500 ft, and thus corresponds to the floral boundary between Lowland Rain Forest and Lower Montane Rain Forest (Whitmore, 1972). Among mammals a similar transition is seen at this altitude in rodents, of which the highland and lowland faunas are very distinct (Table 4).

Among the birds but not among the mammals (with the possible exception of one fruit bat, *Chironax melanocephalus*) a few species are restricted in their distribution to middle altitudes. Adequately attested examples include the trogon *Harpactes erythrocephalus*, Mueller's Barbet *Megalaima oorti*, the bulbuls *Criniger ochraceus*, and *Hypsipetes flavala*, the oriole *Oriolus cruentus*, and the wren-babbler *Napothera epilepidota*. Only three of these, however (*M. oorti*, *C. ochraceus* and *N. epilepidota*) are strictly intermediate in altitudinal zonation, covering the 2500–3500 ft range, and the assemblage does not form a coherent fauna.

Ninety-nine species of birds and 31 species of mammals were identified within the 2000–3900 ft zone of the mountain. Despite its mixed nature this assemblage contains only about two-thirds the number of species recorded near Base camp. Forty-seven species of birds were netted at camps 2½ and 3, indicating that just under half the avifauna was active in the lower storey of the forest. The numbers of birds/net/day at both sites was similar to catches at other altitudes (Table 2).

4. Quantitative comparisons

The preceding subjective examination of the occurrence of birds and mammals on Benom has confirmed that (as expected) there are two main altitudinally exclusive faunas represented in both classes, namely a highland fauna and a lowland fauna, which meet at an intermediate zone where much overlapping occurs and where among birds a few distinctive middle-altitude species are found. It is also clear that this broad pattern is complicated and partly obscured by differences in the distributions of member species of each fauna, which do not all have common altitudinal limits. The most notable overall trend is a progressive reduction in number and diversity of species with increasing altitude.

Two coefficients used by ecologists to compare samples from different areas in terms of the species present can be applied to this situation. One is Jaccard's *coefficient of community*, defined as the number of species common to two areas, expressed as a percentage of the total number of species. More widely used is Soerensen's coefficient, in which the number of species common to the two areas is expressed as a percentage of the mean number of species per area (Greig-Smith, 1964 : 136).

For this comparison, the mountainside can conveniently be divided along the thousand feet contours into seven altitudinal zones. In Tables 5 and 6, the number of species recorded in each zone, the number common to all pairs of zones and the

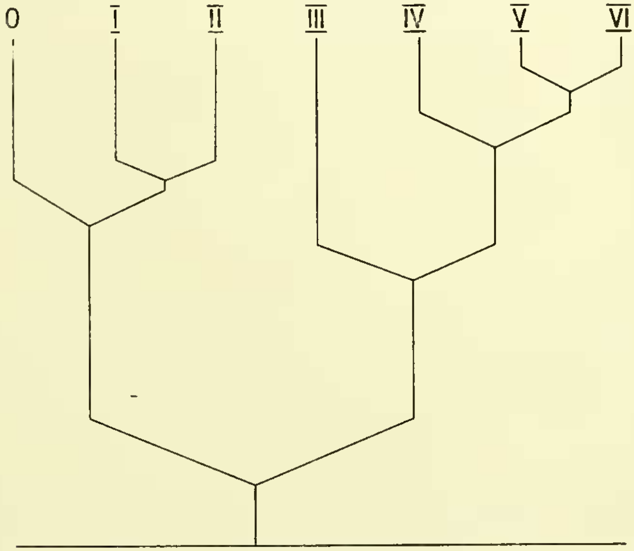

FIG. 1. Dendrogram of Soerensen's coefficient calculated for all birds recorded on Benom in successive altitudinal zones, indicated as follows: 0 = 600–900 ft, I = 1000–1900 ft, II = 2000–2900 ft, III = 3000–3900 ft, IV = 4000–4900 ft, V = 5000–5900 ft, VI = 6000–6916 ft. The heights of the points of furcation above base line are proportional to the combined coefficients.

total present in any combined pair of zones have been recorded. In Table 7, Soerensen's coefficient has been calculated for all possible pairs of zones, for both classes.

The same results can be presented graphically in the form of dendrograms (Figs 1 and 2), obtained by nearest-neighbour sorting of the coefficients expressed in Table 7. This presentation *inter alia* emphasizes the relatively greater distinctiveness of the middle zone (III) among birds, and the greater divergence of highland and lowland faunas among birds compared with the mammals.

These analyses, in terms only of species present, remain crude and far from ideal without reference to variations in the abundance of species at different altitudes. Unfortunately, the means by which distributions were gathered in most cases were too diverse for any reliable quantitative assessment of population densities to be made. The only example of a single technique applied reasonably consistently at all altitudes is mist-netting for birds. Although there are many imponderables, the catches per net/day of any particular species can be taken to indicate broadly its abundance at different altitudes.

By this criterion, certain birds were definitely rarer near the limits of their altitudinal range than at its centre, as illustrated by the catches of the three species of *Alcippe* (Table 2). Although the actual numbers caught are not directly comparable, lists from the different netting areas can be made which rank the species

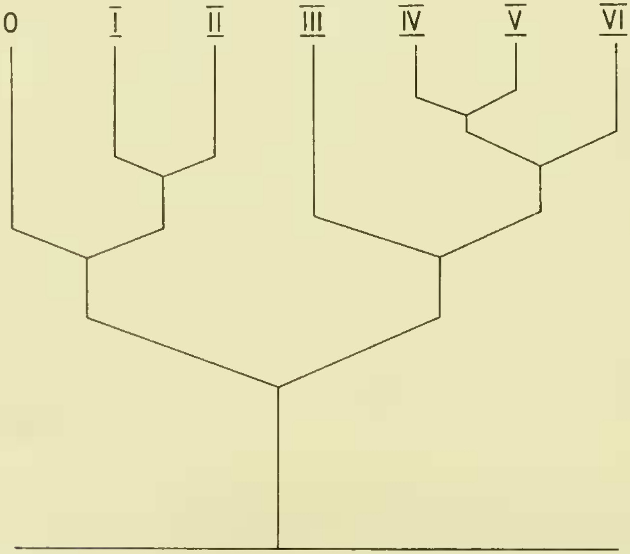

FIG. 2. Dendrogram of Soerensen's coefficient calculated for the mammals of Gunong Benom. Conventions as for Fig. 1.

taken in order of frequency, i.e. the number of individuals netted, with zero ranking if not netted. From these ranked lists the coefficient τ can be derived (Kendall, 1955). In Table 8, values of τ computed for each netting area are given, and in Fig. 3 the corresponding dendrogram again obtained by nearest-neighbour sorting. In these results, the avifaunas sampled by netting near the forest floor are shown to be even more distinctly zoned than indicated by the wider lists including canopy species.

The implications of this difference, and the broader problem of the factors controlling altitudinal zonation, remain the subject of more intensive ecological research which, it is hoped, later visitors to Benom may have the opportunity to pursue.

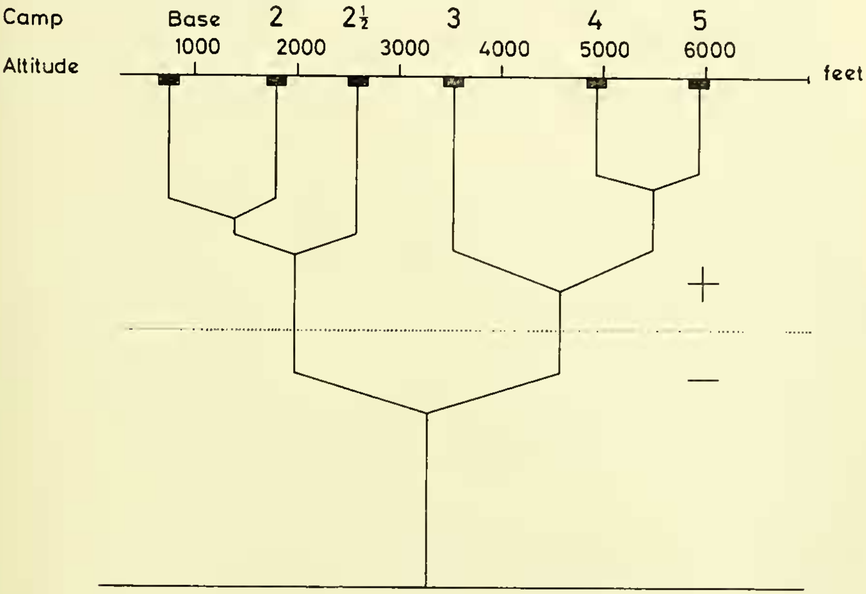

FIG. 3. Dendrogram of τ for ranked lists of birds netted at five stations on Gunong Benom.

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APPENDIX 1

Breeding and moult among birds on Gunong Benom, 11 February–15 April 1967. Observations on breeding are based on specimens autopsied. Females were considered to be in breeding condition if any follicle was 3 mm or more in diameter, or if an egg was found in the oviduct.

		FEMALES							MALES							
Species No.	Species	No.	Weights (g)		Wing (mm)		Reproductive condition		No.	Weights (g)		Wing (mm)		Testis length (mm)		
			Mean	Range	Mean	Range	No. ex'd	No. in breeding cond'n		Mean	Range	Mean	Range	No.	Mean	Range
1.	*Ictinaetus malayensis*	1	—	930	—	530	—	—	—	—	—	—	—	—	—	—
10.	*Ducula badia*	1	—	455·5	—	220	—	—	1	—	414·1	—	233	1	—	14
11.	*Treron curvirostris*	—	—	—	—	—	—	—	1	—	149·2	—	134	1	—	16
12.	*Macropygia ruficeps*	1	—	92·0	—	141	—	—	2	—	70·3, 82·1	—	140, 142	2	—	10, 10·5
13.	*Chalcophaps indica*	2	—	—, 110·0	—	142, 148	2	0	—	—	—	—	—	—	—	—
18.	*Surniculus lugubris*	1	—	40·0	—	140	1	0	—	—	—	—	—	—	—	—
19.	*Phaenicophaeus diardi*	—	—	—	—	—	—	—	1	—	72·2	—	132	1	—	5
20.	*Phaenicophaeus curvirostris*	1	—	167·6	—	172	1	0	—	—	—	—	—	—	—	—
21.	*Phaenicophaeus chlorophaeus*	—	—	—	—	—	—	—	2	—	49·8, 52·4	—	117, 112	1	—	4
22.	*Phaenicophaeus javanicus*	1	—	133·5	—	150	1	1	4	108·8	100·3–122·1	144·3	141–147	4	4·5	4–5
23.	*Otus rufescens*	—	—	—	—	—	—	—	2	—	43·2, 86·4	—	130, 132	2	—	5, 7
24.	*Otus spilocephalus*	2	—	66·6, 93·8	—	134, 139	2	2	4	59·0	55·3–63·4	135·8	133–140	4	6·5	5·5–7
25.	*Otus bakkamoena*	—	—	—	—	—	—	—	1	—	101·2	—	148	1	—	6·5
26.	*Glaucidium brodiei*	—	—	—	—	—	—	—	1	—	58·1	—	87	1	—	5·5
27.	*Phodilus badius*	1	—	230·0	—	191	1	0	—	—	—	—	—	—	—	—
30.	*Harpactes diardii*	1	—	106·1	—	149	1	1	1	—	107·3	—	144	1	—	4
32.	*Harpactes duvaucelii*	2	—	35·5, 40·0	—	103, 115	2	1	3	38·1	36·4–39·3	107·3	106–108	2	—	4, 4
33.	*Harpactes erythrocephalus*	1	—	86·6	—	145	1	1	—	—	—	—	—	—	—	—
35.	*Ceyx rufidorsus*	1	—	16·5	—	59	1	0	2	—	16·8, 17·6	—	61, 62	2	—	5, 5
34.	*Ceyx erithacus*	1	—	14·7	—	59	1	0	—	—	—	—	—	—	—	—
36.	*Halcyon concreta*	2	—	72·6, 77·4	—	109, 113	2	1	3	65·9	60·1–72·3	107·0	107 (all)	3	5	5
38.	*Nyctiornis amicta*	—	—	—	—	—	—	—	1	—	74·4	—	130	1	—	2·5
44.	*Psilopogon pyrolophus*	1	—	145·3	—	129	1	1	1	—	135·5	—	123	1	—	5
45.	*Megalaima chrysopogon*	1	—	185·6	—	127	1	1	2	—	173·1, 180·0	—	127, 128	2	—	10, 7
47.	*Megalaima franklinii*	1	—	64·9	—	98	1	0	2	—	61·4, 73·3	—	97, 99	2	—	6, 7
48.	*Megalaima oorti*	3	73·0	71·1–77·4	96·0	95–97	3	2	—	—	—	—	—	—	—	—
49.	*Megalaima henricii*	1	—	78·1	—	92	1	0	2	—	68·4, 72·6	—	100, 108	2	—	8, 10
50.	*Megalaima australis*	—	—	—	—	—	—	—	1	—	33·8	—	77	1	—	10
51.	*Calorhamphus fuliginosus*	2	—	43·9, 46·5	—	80, 102	2	0	1	—	48·4	—	83	1	—	6
53.	*Sasia abnormis*	1	—	10·4	—	50	1	1	1	—	7·4	—	54	1	—	3
57.	*Meiglyptes tukki*	1	—	47·4	—	111	1	0	1	—	47·4	—	103	1	—	< 1
[illegible]	[illegible]	1	—	71·0	—	111	1	0	0	—	—	—	—	—	—	—

63.	*Calyptomena viridis*	2	—	44·1, 54·1	—	103, 99	2	0	5	52·2	47·5–54·3	101·0	97–104	5	15·8	12–18
64.	*Cymbirhynchus macrorhynchos*	0	—	—	—	—	—	—	1	—	59·4	—	104	1	—	2
66.	*Eurylaimus javanicus*	1	—	74·3	—	102	1	0	1	—	78·5	—	105	—	—	—
67.	*Pitta caerulea*	0	—	—	—	—	—	—	1	—	202·0	—	155	1	—	4
70.	*Coracina novaehollandiae*	2	—	92·1, 92·9	—	162, 160	2	1	3	91·6	88·0–98·3	164·0	163–165	3	7·0	6–8
73.	*Pericrocotus solaris*	3	15·5	15·4–15·6	79·7	78–83	3	0	3	14·3	13·5–15·1	79·1	73–84	2	8·0	7–9
75.	*Pericrocotus flammeus*	0	—	—	—	—	—	—	1	—	24·4	—	85	1	—	8
78.	*Chloropsis cyanopogon*	1	—	19·1	—	80	1	1	2	—	22·7, 22·8	—	91, 85	2	—	7, 8
80.	*Chloropsis cochinchinensis*	0	—	—	—	—	—	—	1	—	25·0	—	86	1	—	3
82.	*Irena puella*	1	—	67·4	—	117	1	1	2	—	75·6, 75·7	—	127, 124	2	—	11, 12
83.	*Pycnonotus squamatus*	1	—	22·8	—	77	1	0	1	—	18·8	—	74	1	—	5
84.	*Pycnonotus cyaniventris*	2	—	21·9, 24·0	—	73, 77	2	0	0	—	—	—	—	—	—	—
86.	*Pycnonotus simplex*	1	—	22·4	—	89	1	1	2	—	25·7, 27·2	—	85, 90	2	—	8, 8
87.	*Pycnonotus erythropthalmos*	2	—	16·5, 18·8	—	72, 75	2	2	0	—	—	—	—	—	—	—
88.	*Criniger bres*	1	—	29·2	—	96	1	0	4	36·0	34·0–39·4	97·5	91–102	3	7·7	6–9
89.	*Criniger ochraceus*	7	39·6	36·7–46·5	104·9	101–110	7	3	5	43·4	39·6–46·9	110·8	109–114	5	8·8	5–10
90.	*Criniger phaeocephalus*	4	27·0	23·6–31·1	88·0	87–89	4	1	6	29·8	24·6–32·7	98·3	93–105	6	6·1	5–8
91.	*Criniger finschii*	1	—	24·4	—	83	1	0	1	—	25·0	—	86	1	—	8
92.	*Hypsipetes criniger*	5	12·3	11·7–12·9	72·2	71–75	5	0	6	15·1	13·3–18·0	79·0	74–82	6	6·0	4–9
93.	*Hypsipetes charlottae*	0	—	—	—	—	—	—	1	—	25·6	—	87	1	—	8
94.	*Hypsipetes macclellandi*	5	32·7	30·0–37·5	96·4	91–102	5	1	7	33·0	27·6–39·9	100·4	95–112	7	8·9	6–11
95.	*Hypsipetes viridescens*	1	—	36·7	—	101	1	0	0	—	—	—	—	—	—	—
96.	*Hypsipetes flavala*	1	—	27·2	—	92	1	1	2	—	34·3, 35·2	—	102, 101	2	—	11, 7
97.	*Dicrurus remifer*	5	39·9	35·5–44·4	129·8	126–135	5	2	5	44·0	38·8–49·0	135·6	131–139	5	11·6	9–15
98.	*Dicrurus paradiseus*	2	—	63·4, 73·5	—	137, 143	2	0	1	—	70·8	—	145	1	—	16·5
102.	*Platylophus galericulatus*	1	—	77·9	—	127	1	0	0	—	—	—	—	—	—	—
103.	*Corvus enca*	0	—	—	—	—	—	—	1	—	508·5	—	335	1	—	9
104.	*Melanochlora sultanea*	0	—	—	—	—	—	—	2	—	36·1, 41·0	—	101, 108	2	—	8, 11
107.	*Pellorneum capistratum*	2	—	26·4–27·6	—	70, 66	2	1	3	28·4	27·5–29·6	68·7	65–71	3	5·3	4–7
108.	*Trichastoma malaccense*	4	19·1	17·5–20·1	68·3	66–71	5	1	4	21·0	19·4–22·4	71·2	68–74	4	5·1	4·5–6
109.	*Trichastoma sepiarium*	1	—	23·4	—	70	—	—	1	—	21·5	—	75	1	—	6
110.	*Trichastoma bicolor*	2	—	19·3, 19·5	—	78, 85	2	0	2	—	22·0, 26·3	—	89, 87	2	—	4, 5
111.	*Malacopteron magnum*	3	24·3	23·8–24·5	84·0	82–85	2	0	5	25·9	24·1–27·7	90·8	85–96	4	4·0	2–5
112.	*Malacepteron cinereum*	3	15·1	12·7–17·0	73·3	70–76	3	0	4	17·3	15·3–18·4	79·3	77–83	4	7·0	5–8
113.	*Malacopteron magnirostre*	4	18·0	16·8–19·0	76·0	75–77	4	0	4	21·2	19·5–24·9	80·3	77–85	4	7·5	5–10
114.	*Malacopteron affine*	1	—	18·6	—	73	1	1	1	—	15·7	—	76	1	—	4
115.	*Pomatorhinus montanus*	1	—	26·8	—	86	1	0	0	—	—	—	—	—	—	—
116.	*Pomatorhinus hypoleucos*	1	—	69·0	—	100	1	0	2	—	70·4, 74·4	—	109, 105	2	—	6, 8
118.	*Napothera macrodactyla*	0	—	—	—	—	—	—	1	—	48·7	—	91	1	—	3
120.	*Napothera brevicaudata*	3	18·0	17·3–19·0	62·7	60–65	3	1	3	19·8	18·2–21·4	63·3	62–65	3	4·0	4
124.	*Macronus ptilosus*	0	—	—	—	—	—	—	1	—	17·0	—	70	1	—	3
125.	*Stachyris nigriceps*	2	—	16·2, —	—	57, 60	2	1	4	15·1	13·8–16·2	62·5	61–64	4	8·5	7–10
126.	*Stachyris poliocephala*	6	22·2	20·1–25·7	67·3	65–72	6	2	3	24·5	23·3–25·9	68·3	67–69	3	3·3	2–4
127.	*Stachyris nigricollis*	0	—	—	—	—	—	—	2	—	25·5, —	—	69, 71	2	—	4, 10
128.	*Stachyris leucotis*	3	23·3	22·8–23·8	66·0	66 (all)	3	1	3	24·1	21·5–26·5	68·7	66–71	3	4·0	2–5
129.	*Stachyris maculata*	3	24·8	23·6–25·8	81·3	79–84	3	0	5	26·8	24·5–29·6	83·6	80–86	5	5·7	4–7·5

Appendix I (contd.)

		FEMALES							MALES							
Species No.	Species	No.	Weights (g)		Wing (mm)		Reproductive condition		No.	Weights (g)		Wing (mm)		Testis length (mm)		
			Mean	Range	Mean	Range	No. ex'd	No. in breeding cond'n		Mean	Range	Mean	Range	No.	Mean	Range
130.	*Stachyris erythroptera*	4	11·6	11·0–12·2	60·0	59–62	4	0	2	—	13·8, 15·1	—	64, 64	2	—	3, 2
131.	*Stachyris chrysea*	1	—	6·3	—	51	1	0	1	—	7·8	—	53	1	—	7
133.	*Garrulax mitratus*	2	—	57·7, 65·2	—	105, 107	2	1	2	67·4	66·5, 68·2	—	107, 113	2	—	9, 14
134.	*Garrulax erythrocephalus*	3	66·3	58·5–72·0	100·7	97–105	3	1	2	—	59·9, 62·8	—	99, 100	2	—	4, 6
135.	*Cutia nipalensis*	1	—	51·3	—	93	1	0	1	—	62·5	—	93	1	—	15
138.	*Alcippe castaneceps*	7	14·4	12·4–17·1	62·8	61–64	7	1	7	13·2	12·4–13·9	64·4	61–68	7	9·1	8–11
139.	*Alcippe peracensis*	7	—	15·5, 15·8	63·1	60–66	8	1	7	14·3	13·1–16·4	65·4	62–68	6	5·4	2–7
140.	*Alcippe brunneicauda*	5	14·4	13·5–15·0	68·4	65–71	5	0	5	14·1	13·3–15·3	71·6	70–72	5	3·3	1–5
141.	*Minla strigula*	1	—	19·6	—	67	1	1	4	19·5	18·7–20·2	66·8	64–69	4	6·5	6–7
143.	*Heterophasia picaoides*	1	—	43·3	—	113	1	0	2	—	40·9, 41·7	—	117, 122	2	—	14, 16
145.	*Copsychus pyrropyga*	1	—	34·5	—	98	1	0	2	—	37·8, 40·1	—	101, 89	2	—	9, 9
146.	*Copsychus malabaricus*	2	—	29·5, 30·5	—	88, 84	2	0	2	—	31·0, 35·8	—	94, 98	2	—	6, 8·5
147.	*Enicurus leschenaulti*	1	—	24·8	—	88	1	0	1	—	34·0	—	93	1	—	2
148.	*Enicurus ruficapillus*	2	—	24·8, 29·9	—	87, 87	2	0	3	29·1	27·9–30·0	92·0	91–93	3	3·3	3–4
152.	*Phylloscopus trivirgatus*	0	—	—	—	—	—	—	3	7·9	7·0–9·3	56·3	55–59	3	4·5	2·5–8
154.	*Seicercus montis*	1	—	5·8	—	56	1	0	1	—	6·5	—	52	1	—	5
155.	*Orthotomus cuculatus*	1	—	5·6	—	42	1	1	1	—	5·6	—	45	1	—	5·5
158.	*Rhipidura albicollis*	7	10·5	9·4–11·7	78·0	76–84	7	0	4	12·8	10·5–14·7	84·5	81–87	4	8·0	8–9
159.	*Rhipidura perlata*	1	—	12·1	—	83	1	0	1	—	12·0	—	91	1	—	7
160.	*Culicicapa ceylonensis*	0	—	—	—	—	—	—	4	7·7	7·0–8·6	61·3	59–63	4	4·0	3–5
164.	*Muscicapa grandis*	2	—	29·0, 34·9	—	99, 94	2	0	9	30·0	27·5–34·9	99·6	97–102	8	8·3	6–10
166.	*Muscicapa hyperythra*	2	—	8·0, 9·6	—	55, 61	3	2	10	7·6	6·3–8·8	60·4	56–66	10	5·8	4–8
167.	*Muscicapa dumetoria*	1	—	8·2	—	55	1	0	2	—	8.5, 9.1	—	62, 60	2	—	4, 3
169.	*Muscicapa westermanni*	0	—	—	—	—	—	—	1	—	—	—	60	1	—	3
172.	*Rhinomyias umbratilis*	2	—	13·8, 14·4	—	72, 73	2	0	2	—	17·8, 16·2	—	76, 78	2	—	2, 6
173.	*Philentoma pyrhoptera*	1	—	16·2	—	80	1	0	4	16·4	14·7–17·6	80·2	77–83	4	6·2	4–8
174.	*Philentoma velata*	3	23·6	22·9–24·2	93·3	89–96	3	0	1	—	26·6	—	100	1	0	6
175.	*Hypothymis azurea*	1	—	11·0	—	68	1	0	2	—	7·3–11·7	—	70, 70	2	—	8, 3
176.	*Terpsiphone paradisi*	1	—	16·3	—	87	1	1	3	18·6	18·1–19·2	96·3	95–98	2	—	9, 10
177.	*Anthreptes simplex*	0	—	—	—	—	—	—	1	—	9·2	—	63	1	—	5
179.	*Hypogramma hypogrammicum*	3	11·1	9·7–12·8	62·7	60–64	3	1	9	10·4	7·8–12·3	65·5	61–70	6	4·9	4–6
182.	*Arachnothera longirostris*	5	12·2	10·8–14·0	61·2	59–63	6	2	7	14·0	12·9–15·6	68·1	65–71	7	6·4	1·5–9
184.	*Arachnothera affinis*	1	—	20·6	—	76	2	0	4	22·6	20·5–24·9	85·5	83–88	4	5·5	3·5–7
185.	*Arachnothera magna*	1	—	23·9	—	90	1	0	4	31·5	30·0–34·5	92·8	89–96	4	6·8	6–8
189.	*Prionochilus maculatus*	2	—	7·8, 7·9	—	52, 54	2	0	3	9·1	7·7–11·8	53·7	51–56	3	4·9	3–6
191.	*Pyrrhula nipalensis*	2	—	19·8, 21·4	—	79, 82	2	0	2	—	18·6, 22·2	—	82, 84	2	—	3, 1·5

MOULT RECORDS

Moult was occurring only among species listed; figures give number in moult (with number examined in parentheses). Primaries numbered centrifugally, secondaries centripetally.

Species No.

37. *_Merops viridis_ 1 (1): female, 23 February 1967, moulting from juvenile to adult plumage.
63. _Calyptomena viridis_ 2 (7): male, 19 February 1967, moulting from juvenile to adult plumage; adult female, 7 April 1967, heavy moult with renewal in humerals and rectrices.
64. _Cymbirhynchus macrorhynchos_ 1 (1): male, 20 February 1967, moulting from juvenile to adult plumage.
76. *_Delichon dasypus_ 1 (1): not sexed, 15 February 1968, heavy moult, with primary VII, secondary III growing.
90. _Criniger phaeocephalus_ 1 (18): adult female, reproductively inactive, 12 February 1967, moult in secondaries.
100. _Oriolus xanthonotus_ 1 (1): male, 14 April 1967, moulting from juvenile to adult plumage.
128. _Stachyris leucotis_ 2 (6): male and female, 27 February, with asymmetrical moult in inner primaries, secondaries and humerals.
130. _Stachyris erythroptera_ 1 (9): adult, 8 April 1967, renewing primary III and secondary I.
138. _Alcippe castaneceps_ 1 (35): adult, 25 March 1967, limited body moult only.
148. _Enicurus ruficapillus_ 1 (6): male, 18 February 1967, heavy moult with primary IV and secondary I growing.
191. _Pyrrhula nipalensis_ 5 (6): 4 adults, 1 subadult, in advanced moult with replacement of the primaries complete or nearly so.

*Palaearctic migrants or non-breeding visitors.

FURTHER BREEDING RECORDS

Species No.

5. _Microhierax fringillarius_: A pair at a hole, apparently nesting, seen repeatedly in February 1967.
12. _Macropygia ruficeps_: A typical columbiform nest, with one broken white egg on the ground below, found at 6650 ft, 10 April 1967.
65. _Eurylaimus javanicus_: A pair built at least two nests high in the tualang tree overhanging Base camp in February–March 1967; successful breeding was not confirmed. Juveniles, a male and a female, collected on 8 April 1967.
107. _Pellorneum capistratum_: Juvenile netted on 10 February 1967.
112. _Malacopteron cinereum_: Juveniles netted on 10, 16, 17 and 21 February 1967.
113. _Malacopteron magnirostre_: A juvenile netted on 20 February 1967.
117. _Napothera epilepidota_: Nesting February 1968.
130. _Stachyris erythroptera_: Juvenile netted on 9 April 1967.
134. _Garrulax erythrocephalus_: Adult with two newly fledged young seen on 26 March 1967.
140. _Alcippe brunneicauda_: Juvenile netted on 8 April 1967.
145. _Copsychus pyrropyga_: Juvenile netted on 8 April 1967.
148. _Enicurus ruficapillus_: Juvenile netted on 14 February 1967.
182. _Arachnothera longirostris_: Juvenile netted on 11 April 1967.
191. _Pyrrhula nipalensis_: Juveniles, male and female, collected 26 March 1967.

APPENDIX 2

Breeding condition among female mammals on Gunong Benom, 11 February–15 April 1967. Observations are based on specimens autopsied.

Species No.	Species	Number of females			Number of foetuses		Notes
		Examined	Lactating	Pregnant	Mean	Range	
3.	*Cynocephalus variegatus*	1	0	1	1	—	*
4.	*Cynopterus brachyotis*	1	0	1	1	—	*
6.	*Balionycteris maculata*	1	0	1	1	—	*
7.	*Chironax melanocephalus*	3	0	1	1	—	
8.	*Megaerops ecaudatus*	2	0	2	1	1	
9.	*Macroglossus minimus*	1	0	0	—	—	
12.	*Rhinolophus affinis*	7	1	4	1	1	*
13.	*Rhinolophus stheno*	6	0	5	1	1	*
14.	*Rhinolophus refulgens*	9	0	9	1	1	*
15.	*Rhinolophus macrotis*	1	0	1	1	—	*
16.	*Rhinolophus trifoliatus*	3	0	3	1	1	
18.	*Hipposideros galeritus*	1	1	0	—	—	*
19.	*Hipposideros diadema*	1	0	1	1	—	*
22.	*Murina cyclotis*	1	0	1	2	—	*
30.	*Presbytis obscura*	2	0	1	1	—	*
37.	*Ratufa bicolor*	1	0	1	1	—	*
38.	*Ratufa affinis*	1	0	0	—	—	
39.	*Callosciurus notatus*	1	0	0	—	—	
41.	*Callosciurus flavimanus*	4	0	1	1	—	*
42.	*Callosciurus nigrovittatus*	4	0	1	2	—	*
44.	*Sundasciurus tenuis*	2	1	0	—	—	*
45.	*Sundasciurus lowii*	1	0	0	—	—	
46.	*Tamiops macclellandii*	1	0	1	3	—	
47.	*Lariscus insignis*	2	0	0	—	—	
48.	*Rhinosciurus laticaudatus*	1	0	0	—	—	
49.	*Iomys horsfieldii*	1	0	1	3	—	*
51.	*Petaurista petaurista*	3	0	2	1	—	*
53.	*Rattus tiomanicus*	1	0	0	—	—	
54.	*Rattus muelleri*	2	0	0	—	—	
55.	*Rattus bowersii*	2	0	0	—	—	
56.	*Rattus cremoriventer*	1	1	0	—	—	*
58.	*Rattus rajah*	2	0	0	—	—	
59.	*Rattus inas*	5	2	2	3, 4	—	*
60.	*Rattus whiteheadi*	4	2	1	3	—	*
61.	*Rattus sabanus*	18	5	1	2	—	*
62.	*Rattus edwardsi*	5	4	0	—	—	
67.	*Arctogalidia trivirgata*	1	0	0	—	—	
73.	*Tragulus javanicus*	1	0	1	1	—	

Notes to Appendix 2

3. 5 March; foetus in left uterine horn, weight 24·5 g.
4. 20 February; foetus in left uterine horn.
6. 25 February; foetus in left uterine horn.
12. All implantations in right uterine horn; all pregnancies in February, lactating on 11 March.
13. All specimens 9–25 February; all implantations in right uterine horn.

14. All specimens 12–25 February; all implantations in right uterine horn.
15. 23 February; implantation site not noted.
16. 10–21 February; implantation noted for one specimen only; in right horn.
18. 8 March.
19. 11 February.
22. 20 February.
30. Both dated 3 March; one with advanced foetus, the other with a ripe graafian follide in the left ovary.
37. 10 April; implanted in right uterus.
41. The single pregnancy on 18 March; implanted in right uterus.
42. Pregnancy on 9 March.
44. Lactating on 10 April.
46. 2 April; all foetuses in left uterus.
49. 7 March; 2 foetuses in left uterus, 1 in right.
51. Pregnancies on 16 and 23 February; both implanted in right uterus.
56. Lactating on 10 March.
59. 23 March, lactating, not pregnant; 10 April, gave birth to 3 young in the trap; lactating and also pregnant, presumably as a consequence of post-partum oestrus with 4 embryos all in the right uterus.
60. Pregnant on 1 March, all foetuses in the right uterus; lactating and not pregnant on 8, 14 March.
61. Pregnancy on 24 February, both foetuses in right uterus.
73. 23 February.

TABLE I

ALTITUDINAL RECORDS OF FOREST BIRDS ON GUNONG BENOM

Records for each species within the observed limits of its altitudinal range are given by symbols representing 100 ft intervals: n = netted, x = collected by other means, s = sight record or vocalisation, - = presence inferred.

Species No.		Altitude ('000 ft) 1 2 3 4 5 6
1.	*Ictinaetus malayensis*	x
2.	**Hieraaetus kienerii*	x-s
3.	*Spilornis cheela*	s--------s-----------------s-s
4.	*Spizaetus alboniger*	s
5.	*Microhierax fringillarius*	s------s
6.	*Polyplectron inopinatum*	x
7.	*Argusianus argus*	ss------s-xs-------s--s
8.	*Rollulus rouloul*	x
9.	*Rhizothera longirostris*	s-------------------------s-s
10.	*Ducula badia*	ss-------------s-ss------x
11.	*Treron curvirostra*	x
12.	*Macropygia ruficeps*	s-s---x---x-----------------------s-------s---------sx-----x
13.	*Chalcophaps indica*	nn
14.	*Loriculus galgulus*	s-s-------s------ss------s
15.	*Cuculus micropterus*	s-----s---s-------s
16.	*Cuculus sparverioides*	s-s--------s-------s
17.	*Chrysococcyx xanthorhynchus*	s------s
18.	*Surniculus lugubris*	n--------s
19.	*Phaenicophaeus diardi*	x
20.	*Phaenicophaeus curvirostris*	x---------s

Table 1 (contd).

Species No.	Altitude ('000 ft)	1 2 3 4 5 6
21.	*Phaenicophaeus chlorophaeus*	sx--x--------------s
22.	*Phaenicophaeus javanicus*	x----------n-s------s
23.	*Otus rufescens*	n--n
24.	*Otus spilocephalus*	s----------------n----------n
25.	*Otus bakkamoena*	n-----------s
26.	*Glaucidium brodiei*	s---------s-----------------n
27.	*Phodilus badius*	n
28.	*Chaetura leucopygialis*	s---------ss
29.	*Hemiprocne comata*	x----------s
30.	*Harpactes diardii*	s---------s------n
31.	*Harpactes oreskios*	s
32.	*Harpactes duvaucelii*	x-------x-----------n
33.	*Harpactes erythrocephalus*	n-------s
34.	**Ceyx erithacus*	n
35.	*Ceyx rufidorsus*	n
36.	*Halcyon concreta*	n-------------------n
37.	**Merops viridis*	x--s------s--------s
38.	*Nyctiornis amicta*	s--------n-s
39.	*Berenecornis comatus*	s
40.	*Rhyticeros undulatus*	s-----s----------------------ss---s
41.	*Anorhinus galeritus*	sx----------s-------s----------s
42.	*Buceros rhinoceros*	s---s--s--s-------s-s
43.	*Rhinoplax vigil*	s----s-------------ss------s--s
44.	*Psilopogon pyrolophus*	sx-x------x------x-s--------s
45.	*Megalaima chrysopogon*	s------x------------x--s------s

Table 1 (contd.)

Species No.	Altitude ('000 ft)	1	2	3	4	5	6
46.	*Megalaima mystacophanos*	s-s-----ss					
47.	*Megalaima franklinii*				x-s-----s-------s		
48.	*Megalaima oorti*		s-----s----xx--s				
49.	*Megalaima henricii*	x-----x-----------s					
50.	*Megalaima australis*	s-----x-----------s-s					
51.	*Calorhamphus fuliginosus*	x-s-----s-------s					
52.	*Indicator archipelagicus*	x					
53.	*Sasia abnormis*	n-----------------n					
54.	*Picus puniceus*	s----s--x					
55.	*Picus chlorolophus*				s-s-s-------x		
56.	*Picus mentalis*			x			
57.	*Meiglyptes tukki*	n--------------------------n					
58.	*Meiglyptes tristis*		s				
59.	*Blythipicus pyrrhotis*					s	
60.	*Blythipicus rubiginosus*	s---------x------s--------s					
61.	*Chrysocolaptes validus*	x--x----------s					
62.	*Hemicercus concretus*	s					
63.	*Calyptomena viridis*	n---------n-------n					
64.	*Cymbirhynchus macrorhynchos*	x					
65.	*Eurylaimus ochromalus*	x--s-----s-------s					
66.	*Eurylaimus javanicus*	sx----x--s					
67.	*Pitta caerulea*	x					
68.	**Pitta sordida*	x					
69.	*Coracina fimbriata*		s				
70.	*Coracina novaehollandiae*			x-x-------------------x			

Table 1 (contd.)

Species No.		Altitude ('000 ft) 1 2 3 4 5 6
71.	*Hemipus hirundinaceus*	s
72.	*Hemipus picatus*	s
73.	*Pericrocotus solaris*	s-sx----------s--s-ss--s---x-------
74.	*Pericrocotus cinnamomeus*	s---------s
75.	*Pericrocotus flammeus*	x-s-------s
76.	**Delichon dasypus*	x
77.	*Aegithina lafresneyi*	s
78.	*Chloropsis cyanopogon*	x-s-------n
79.	*Chloropsis sonnerati*	s
80.	*Chloropsis cochinchinensis*	s-s----xs-sx-----ss-------s-s
81.	*Chloropsis hardwickii*	s-----s
82.	*Irena puella*	x--x----sss
83.	*Pycnonotus squamatus*	xx----s
84.	*Pycnonotus cyaniventris*	sx---------n
85.	*Pycnonotus brunneus*	s------s
86.	*Pycnonotus simplex*	x---------s------s
87.	*Pycnonotus erythrophthalmos*	x---------xn------x
88.	*Criniger bres*	n---------xn
89.	*Criniger ochraceus*	n----------n
90.	*Criniger phaeocephalus*	n---------n--------n
91.	*Criniger finschi*	x----x
92.	*Hypsipeles criniger*	n------s-sn--------n
93.	*Hypsipetes charlottae*	x-ss
94.	*Hypsipetes macclellandii*	sx-----ss------x-----x---x------s
95.	*Hypsipetes viridescens*	x-sss------s

Table 1 (contd.)

Species No.	Altitude ('000 ft)	1	2	3	4	5	6
96.	*Hypsipetes flavala*	ss-n-----s-----------n					
97.	*Dicrurus remifer*	ss---------s-------n-------------sn--s--s-n-n					
98.	*Dicrurus paradiseus*	n					
99.	*Dicrurus annectans*	s----ss-x					
100.	*Oriolus xanthonotus*	xx					
101.	*Oriolus cruentus*			s-------s-s			
102.	*Platylophus galericulatus*	s------------------n					
103.	*Corvus enca*	x--------s					
104.	*Malanochlora sultanea*	s--s------------s----------x---s					
105.	*Sitta frontalis*	s------s					
106.	*Sitta azurea*					s	
107.	*Pellorneum capistratum*	n					
108.	*Trichastoma malaccense*	n---------n-------nn					
109.	*Trichastoma sepiarium*	n					
110.	*Trichastoma bicolor*	n					
111.	*Malacopteron magnum*	n---------n					
112.	*Malacopteron cinereum*	n---------n--------n					
113.	*Malacopteron magnirostre*	n---------n-----ss-n					
114.	*Malacopteron affine*	n					
115.	*Pomatorhinus montanus*		s-s----s-n				
116.	*Pomatorhinus hypoleucos*			n-s-s------------s------n-----s			
117.	*Napothera epilepidota*		s---------s				
118.	*Napothera macrodactyla*	n					
119.	*Napothera loricata*		n				
120.	*Napothera brevicaudata*			sn-------------n-------n-n			

Table 1 (contd.)

Species No.	Altitude ('000 ft)	1	2	3	4	5	6
121.	*Kenopia striata*	x					
122.	*Microura pusilla*			s---	----------	-s-s--------	s
123.	*Macronus gularis*	s--------s-	-------s				
124.	*Macronus ptilosus*	n					
125.	*Stachyris nigriceps*	n---------	---------n--	--------sn			
126.	*Stachyris poliocephala*	n---------	-n				
127.	*Stachyris nigricollis*		n				
128.	*Stachyris leucotis*	n---------	-n---------sn				
129.	*Stachyris maculata*	n---------	-n				
130.	*Stachyris erythroptera*	n---------	-n----s---n				
131.	*Stachyris chrysea*			ss--	---s-------sn	--s--s-n-n	
132.	*Garrulax lugubris*			x---	---s		
133.	*Garrulax mitratus*			x---	-----------sn	---x	
134.	*Garrulax erythrocephalus*				x----sn	--s-------n-	-----s
135.	*Cutia nipalensis*				sn	-----------x-	--s
136.	*Pteruthius melanotis*				s-	--s-------x	
137.	*Pteruthius flaviscapis*			s**x**-s--	-s----------	--ss	
138.	*Alcippe castaneceps*			n----	------------n	--s-------n	
139.	*Alcippe peracensis*		n--	------ssn---	------s------n	--s--s---n	
140.	*Alcippe brunneicauda*	n-s-------sn	-------s-n				
141.	*Minla strigula*					ss-------n-	----x-xs
142.	*Yuhina zantholeuca*	ss-	-----ss-----	-------s			
143.	*Heterophasia picaoides*		s		---x-	-------x--x--	--s
144.	**Erithacus cyane*	n----------nn	---------n				
145.	*Copsychus pyrropyga*	n-	-----s-n				

Table 1 (contd.)

Species No.	Altitude ('000 ft)	1	2	3	4	5	6
146.	*Copsychus malabaricus*	n-----s-s-n					
147.	*Enicrurus leschenaulti*	n					
148.	*Enicrurus ruficapillus*	n---------n					
149.	*Gerygone fusca*	s--s--s---s------s-------s					
150.	**Phylloscopus coronatus*	s---------s-----------------------s					
151.	**Phylloscopus borealis*		--s--				
152.	*Phylloscopus trivirgatus*					sn-n	
153.	*Seicercus castaniceps*			ss			
154.	*Seicercus montis*					s--s-n-n	
155.	*Orthotomus cuculatus*				s-s-----n-ss------n-------s		
156.	*Orthotomus sericeus*	s					
157.	*Orthotomus atrogularis*	s-sss					
158.	*Rhipidura albicollis*			s-n-------s----ss-----s-n-n---s---s			
159.	*Rhipidura perlata*	n--------sn-s----sn					
160.	*Culicicapa ceylonensis*	n---------s-----------------sn-----s					
161.	**Muscicapa latirostris*	s----------s---s					
162.	**Muscicapa sibirica*		s				
163.	**Muscicapa ferruginea*		s				
164.	*Muscicapa grandis*				s---------n-s---s---n		
165.	**Muscicapa rubeculoides*	n--------sn					
166.	*Muscicapa hyperythra*				s-nn-------s-n------s		
167.	*Muscicapa dumetoria*	n					
168.	*Muscicapa unicolor*	s					
169.	*Muscicapa westermanni*			s---x-----s-----------n			
170.	*Muscicapa solitaris*			n			

Table 1 (contd.)

Species No.		Altitude ('000 ft) 1 — 2 — 3 — 4 — 5 — 6
171.	*Muscicapa hodgsoni*	sn-----s---------------s-s
172.	*Rhinomyias umbratilis*	s--n------s-n
173.	*Philentoma pyrhoptera*	n---------n--------n
174.	*Philentoma velatum*	n-----x---n--------n
175.	*Hypothymis azurea*	n-------s----------n
176.	*Terpsiphone paradisi*	x-----------n
177.	*Anthreptes simplex*	n
178.	*Anthreptes singalensis*	s
179.	*Hypogramma hypogrammicum*	n---------n--------n-----------s
180.	*Aethopyga saturata*	ss------------ss--s------s------s
181.	*Aethopyga mystacalis*	s
182.	*Arachnothera longirostris*	n-----s---n--------n---------n
183.	*Arachnothera robusta*	s
184.	*Arachnothera affinis*	n-s---s-s-n
185.	*Arachnothera magna*	n----------n-sn
186.	*Dicaeum ignipectus*	ss-------------------s
187.	*Dicaeum trigonostigma*	s
188.	*Dicaeum agile*	s
189.	*Prionochilus maculatus*	n-------s-n--------n--------s
190.	*Zosterops everetti*	ss-s-----------------s
191.	*Pyrrhula nipalensis*	n-----s---sx

* Migrant or non-breeding visitor.

TABLE 2

SUMMARY OF MIST-NETTING CATCHES OF BIRDS

Camp	Base	2	2½	3	4	5
Altitude (ft)	700–900	1600–1700	2500–2600	3500–3600	4700–5000	5800–6000
Net/days	166	104	80	159	90	98
No. species netted	45	34	31	19	16	19
Total birds netted	266	114	79	76	60	81
Birds/net/day	1·6	1·1	1·0	0·5	0·7	0·8
Mean birds/species	5·9	3·4	2·5	4·0	3·8	4·3
Arachnothera longirostris	96	17	11	4	0	0
Alcippe brunneicauda	4	8	4	0	0	0
Alcippe peracensis	0	0	1	28	6	8
Alcippe castaneceps	0	0	0	2	11	22

TABLE 3

MAMMALS CAUGHT IN CAGE-TYPE TRAPS ON GUNONG BENOM, 1967

Altitude range (ft)	< 1000	1–1900	2–2900	3–3900	4–4900	5–5900	> 6000	Total
Trap-nights	3380	1716	155	200	122	104	100	5777
Echinosorex gymnurus	1	—	—	—	—	—	—	1
Tupaia minor	1	—	—	—	—	—	—	1
Callosciurus notatus	6	—	—	—	—	—	—	6
Callosciurus caniceps	1	—	—	—	—	—	—	1
Callosciurus nigrovittatus	5	—	—	—	—	—	—	5
Sundasciurus tenuis	1	—	—	—	—	—	—	1
Sundasciurus lowii	1	1	—	—	—	—	—	2
Lariscus insignis	2	1	—	—	—	—	—	3
Rhinosciurus laticaudatus	4	—	—	—	—	—	—	4
Iomys horsfieldii	4	—	—	—	—	—	—	4
Rattus tiomanicus	—	—	—	1	—	—	—	1
Rattus muelleri	6	—	—	—	—	—	—	6
Rattus bowersii	3	—	—	—	—	—	—	3
Rattus cremoriventer	3	—	—	—	—	—	—	3
Rattus surifer	—	—	1	—	—	—	—	1
Rattus rajah	4	6	1	—	—	—	—	11
Rattus inas	—	—	—	1	1	2	5	9
Rattus whiteheadi	3	1	1	—	—	—	—	5
Rattus sabanus	32	4	1	—	—	—	—	37
Rattus edwardsi	—	—	—	2	4	2	3	11
Total	77	13	4	4	5	4	8	115
Catch/100 trap nights	2·3	0·76	2·6	2·0	4·1	3·8	8	2·0
Total species	16	5	4	3	2	2	2	20

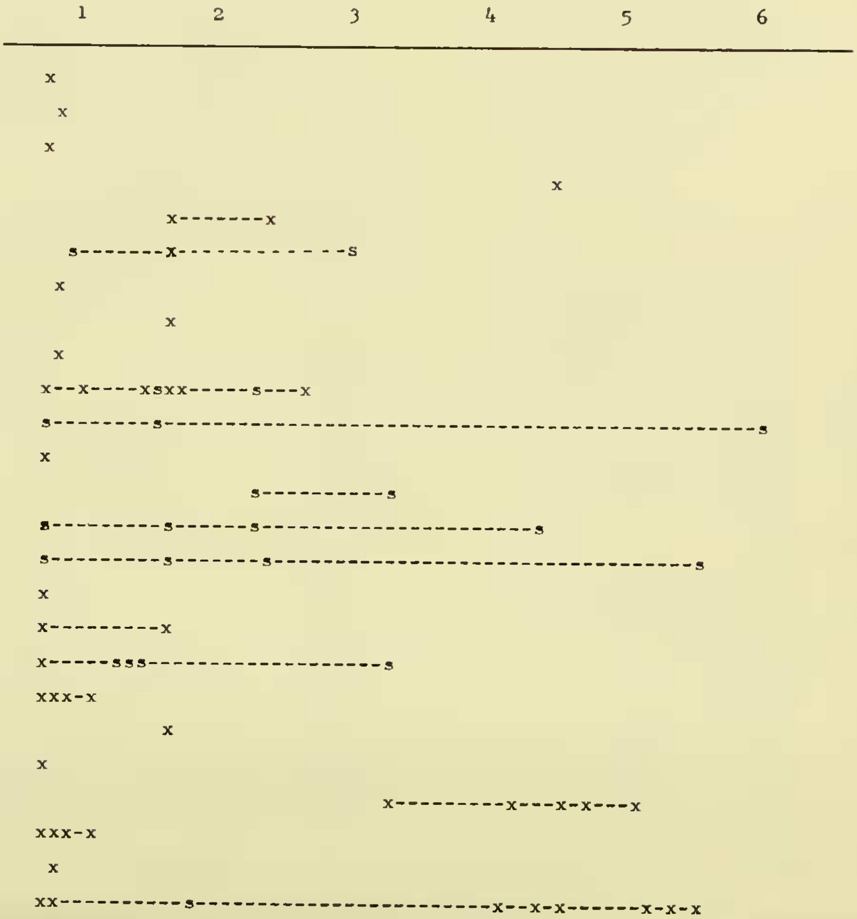
TABLE 4

ALTITUDINAL RECORDS OF FOREST MAMMALS ON GUNONG BENOM

Records for each species within the observed limits of its altitudinal range are given by symbols representing 100 ft intervals: x = specimen collected, s = sight record, t = tracks or other traces, * = material in carnivore dung, - = presence inferred.

Species No.	Altitude ('000 ft)	1	2	3	4	5	6
1.	*Echinosorex gymnurus*	x					
2.	*Crocidura fuliginosa* (?)					s	
3.	*Cynocephalus variegatus*	xx					
4.	*Cynopterus brachyotis*	x--------	--x				
5.	*Penthetor lucasi*			x			
6.	*Balionycteris maculata*	x---------	x				
7.	*Chironax melanocephalus*	x------	----------	-------x--	--------xx	-x	
8.	*Aethalops alecto*						x
9.	*Megaerops ecaudatus*	x					
10.	*Macroglossus minimus*	xx					
11.	*Emballonura monticola*	s------x					
12.	*Rhinolophus affinis*	x-x-------	xx------x				
13.	*Rhinolophus stheno*	x-x-------	xx------x	---------x			
14.	*Rhinolophus refulgens*	xxx-------	xx--------	-------x			
15.	*Rhinolophus macrotis*	x--------	--------x-	--------x			
16.	*Rhinolophus trifoliatus*	x					
17.	*Hipposideros bicolor*	x					
18.	*Hipposideros galeritus*	x					
19.	*Hipposideros diadema*	x					
02.	*Pipistrellus javanicus*		x				

Table 4 (contd.)



Species No.		Altitude ('000 ft)
21.	*Pipistrellus ridleyi*	x
22.	*Pipistrellus societatis*	x
23.	*Murina cyclotis*	x
24.	*Murina huttoni*	x
25.	*Kerivoula papillosa*	x-------x
26.	*Tupaia glis*	s-------x------------s
27.	*Tupaia minor*	x
28.	*Ptilocercus lowii*	x
29.	*Nycticebus coucang*	x
30.	*Presbytis obscura*	x--x----xsxx-----s---x
31.	*Presbytis melalophos*	s--------s--s
32.	*Macaca fascicularis*	x
33.	*Macaca nemestrina*	s----------s
34.	*Hylobates lar*	s---------s------s---------------------s
35.	*Hylobates syndactylus*	s---------s-------s-----------------------------------s
36.	*Manis javanica*	x
37.	*Ratufa bicolor*	x---------x
38.	*Ratufa affinis*	x-----sss------------------s
39.	*Callosciurus notatus*	xxx-x
40.	*Callosciurus prevostii*	x
41.	*Callosciurus caniceps*	x
42.	*Callosciurus flavimanus*	x---------x---x-x---x
43.	*Callosciurus nigrovittatus*	xxx-x
44.	*Sundasciurus hippurus*	x
45.	*Sundasciurus tenuis*	xx---------s------------------------x--x-x------x-x-x

Table 4 (contd.)

Species No.	Altitude ('000 ft)	1 2 3 4 5 6
46.	*Sundasciurus lowii*	x---x
47.	*Tamiops macclellandii*	x--------x---xx---------x
48.	*Lariscus insignis*	xxxx-x
49.	*Rhinosciurus laticaudatus*	xx
50.	*Hylopetes spadiceus*	x
51.	*Iomys horsfieldii*	x--------------------------------------x
52.	*Pteromyscus pulverulentus*	x
53.	*Aeromys tephromelas*	x----------------x
54.	*Petaurista petaurista*	xxx----xx
55.	*Petaurista elegans*	xx
56.	*Chiropodomys gliroides*	s---------x
57.	*Rattus tiomanicus*	x
58.	*Rattus muelleri*	xx
59.	*Rattus bowersii*	x
60.	*Rattus cremoriventer*	xx
61.	*Rattus surifer*	x
62.	*Rattus rajah*	xx---x----x-------x
63.	*Rattus inas*	x-------------x---------x-x
64.	*Rattus whiteheadi*	x-x-------------x
65.	*Rattus sabanus*	xxx-xx--x-x-----------x
66.	*Rattus edwardsi*	xx---x-------x-x---------x
67.	*Atherurus macrourus*	*
68.	*Helarctos malayanus*	t-------ts------
69.	*Prionodon linsang*	x
70.	*Arctictis binturong*	x

Table 4 (contd.)

Species No.	Altitude ('000 ft)	1 2 3 4 5 6
71.	*Arctogalidia trivirgata*	x--s
72.	*Hemigalus derbyanus*	x
73.	*Panthera tigris*	t
74.	*Panthera pardus*	t
75.	*Felis bengalensis*	sx
76.	*Elephas maximus*	tt
77.	*Tapirus indicus*	-t------tt-t------t---------------t-t-t-t-t-t-t--t-t-t-t-t-t
78.	*Sus sp.*	t------t--t------t------------------------------t
79.	*Tragulus javanicus*	x---s
80.	*Muntiacus muntjak*	t
81.	*Capricornis sumatraensis*	s------------------t

Table 5

Relations between bird faunas of different altitudinal zones. Figures give the total number of species in each category

	Altitude zone ('000 ft)	SPECIES IN COMMON						
		< 1	1–1·9	2–2·9	3–3·9	4–4·9	5–5·9	6–6·9
TOTAL SPECIES	< 1	*109*	80	53	20	4	2	1
	1–1·9	141	*112*	64	24	5	4	3
	2–2·9	126	118	*70*	28	7	4	2
	3–3·9	145	144	99	*56*	31	25	17
	4–4·9	148	130	106	68	*43*	34	27
	5–5·9	146	147	105	80	48	*39*	31
	6–6·9	139	140	99	69	47	39	*31*

Table 6

Relations between mammal faunas of different altitudinal zones Figures give the total number of species in each category

	Altitude zone ('000 ft)	SPECIES IN COMMON						
		< 1	1–1·9	2–2·9	3–3·9	4–4·9	5–5·9	6–6·9
TOTAL SPECIES	< 1	*62*	33	22	14	8	8	5
	1–1·9	69	*40*	23	14	9	8	5
	2–2·9	56	42	*25*	15	9	7	5
	3–3·9	70	47	31	*21*	12	11	6
	4–4·9	67	45	30	23	*14*	12	9
	5–5·9	67	45	29	23	15	*13*	9
	6–6·9	67	45	29	23	15	14	10

Table 7

Soerensen's coefficient calculated for the bird and mammal faunas of successive 1000-ft altitudinal zones

Altitude zone ('000 ft)	< 1	1–1·9	2–2·9	3–3·9	4–4·9	5–5·9	6–6·9
				BIRDS			
< 1		72	59	24	5·2	2·7	1·4
1–1·9	65		71	29	6·5	5·3	4·2
2–2·9	51	71		44	12	7·3	4·1
3–3·9	34	46	65		63	53	39
4–4·9	21	33	46	69		83	73
5–5·9	21	30	37	65	86		89
6–6·9	14	20	29	39	75	78	
				MAMMALS			

TABLE 8

VALUES OF τ (INCLUDING COMMON 0) FOR BIRD SPECIES LISTS FROM SIX NETTING SITES ON GUNONG BENOM

Camp	Base	2	2½	3	4	5
2	0·44					
2½	0·25	0·35				
3	−0·27	−0·26	−0·10			
4	−0·41	−0·35	−0·30	0·21		
5	−0·42	−0·36	−0·30	0·14	0·56	—

ADDENDUM

In a recent publication, Medway & Wells (1971) have listed the mammals and birds recorded during a survey of 200 ha of forest at 200–250 ft elevation near Kuala Lompat (102°15′E, 3°42′N), in the lowlands flanking the south-eastern slopes of Gunong Benom. The area sampled lies on the true right bank of the Kerau river at its confluence with the Lompat. Base camp of the 1967 expedition was situated in the upper reaches of the same catchment. The fauna of Kuala Lompat can thus be accepted as representative of that formerly occurring at similar elevations below Base camp, on land where the natural vegetation has since been cleared.

Excluding preliminary visits, the survey at Kuala Lompat was limited to five days of continuous observation. This period was too brief to yield an exhaustive list of the mammals present. Comparatively little effort was made to obtain nocturnal forms (including bats, flying squirrels and small carnivores) which were inadequately sampled. With these limitations, the total number of mammal species recorded was 56 (Table *A*). Of those not previously found on Benom itself, the two rats (Harrison, 1957), the common palm civet (Medway, 1969), the sambhur (Kitchener, 1961) and the gaur (Weigum, 1970) normally frequent, or are even restricted to grassland, past or present cultivation, or human habitation—habitats absent at higher elevations on north-east Gunong Benom. Differences in the bat fauna must be attributed in part, at least, to irregularities in sampling.

In contrast to the obviously incomplete list of mammals, the birds were more effectively tallied. In all, 154 species were identified of which 148 (including 11 migrants) were found in forest, the forest edge or the banks of rivers and streams running through the forest. This forest-adapted fauna shows affinity with the lowland community found on north-east Gunong Benom. It included 82 species recorded at 600–1000 ft, and a further 12 observed in 1967–68 at higher altitudes within the lowland range (Table *B*, *cf.* Table 1 above).

It also, however, exhibits an increased diversity with a total of 45 additional species not noted on the slopes of the mountain (Table *B*). Although some of these birds may have been missed by accidents of collection, or otherwise overlooked during the expeditions of 1967–68, many are clearly restricted by their ecology to lowland habitats including the riparian biotope. The Kuala Lompat list thus further emphasizes the altitudinal specializations exhibited by Malayan birds, stressing in particular the great diversity of the avifauna of the extreme lowlands and the existence of patterns of zonation within the first 1000 ft above sea level.

TABLE *A*

Mammals recorded at Kuala Lompat. Species marked * were not found on north-east Gunong Benom

**Cynopterus horsfieldi*
Cynopterus brachyotis
Balionycteris maculata
Penthetor lucasi
Macroglossus minimus
**Eonycteris spelaea*
**Nycteris javanica*
Rhinolophus stheno
Rhinolophus refulgens
Rhinolophus trifoliatus
**Rhinolophus luctus*
**Hipposideros sabanus*
Hipposideros galeritus
**Hipposideros armiger*
Hipposideros diadema
**Myotis mystacinus*
Murina cyclotis
**Murina suilla*
Tupaia glis
Tupaia minor
Presbytis obscura
Presbytis melalophos
Macaca fascicularis
Macaca nemestrina
Hylobates lar
Hylobates syndactylus
Manis javanica
Ratufa bicolor
Ratufa affinis
Callosciurus notatus
Callosciurus caniceps
Callosciurus prevostii
Sundasciurus hippurus
Sundasciurus tenuis
Sundasciurus lowii
Rhinosciurus laticaudatus
Petaurista petaurista
Rattus tiomanicus
**Rattus argentiventer*
**Rattus exulans*
Rattus muelleri
Rattus bowersii
Rattus cremoriventer
Rattus surifer
Rattus rajah
Rattus whiteheadi
Rattus sabanus
**Paradoxurus hermaphroditus*
Elephas maximus
Sus scrofa
Tragulus javanicus
**Tragulus napu*
Muntiacus muntjak
**Cervus unicolor*
**Bos gaurus*

TABLE *B*

Comparative listings of the forest birds of Kuala Lompat and of lowland elevations on north-east Gunong Benom

i. Species found at Kuala Lompat, but not on Benom: *Pernis ptilorhynchus, Ixobrychus cinnamomeus, Ciconia stormi, Lophura erythrophthalma, Treron capellei, Treron olax, Ptilinopus jambu, Psittinus cyanurus, Cuculus vagans,* *Cacomantis variolosus, Chrysococcyx malayanus, Phoenicophaeus sumatranus, Centropus rectungis, Ninox scutulata, Eurostopodus temminckii, Hemiprocne longipennis, Harpactes kasumba, Harpactes orrhophaeus, Halcyon pileata, Anthracocerus malayanus, Anthracocerus coronatus, Micropternus brachyurus, Dinopium rafflesii, Muelleripicus pulverulentus, Dryocopus javensis, Corydon sumatrana, Pitta granatina, Pitta guajana, Coracina striata, Pericrocotus roseus, Pycnonotus eutilotus, Pycnonotus melanoleucos, Pycnonotus atriceps, Pycnonotus zeylanicus, Pycnonotus finlaysoni, Dicrurus aeneus, Platysmurus leucopterus, Trichastoma rostratum, Prinia rufescens, Orthotomus ruficeps, Orthotomus sutorius, Rhynomyias brunneata, Lanius tigrinus, Anthreptes malacensis, Nectarinia sperata, Gracula religiosa.*

ii. Species found at Kuala Lompat, not observed under 1000 ft on Benom but recorded there at higher elevations: *Rollulus rouloul, Nyctiornis amicta, Coracina fimbriata, Hypsipetes charlottae, Pomatorhinus montanus, Stachyris nigricollis, Orthotomus atrogularis, Muscicapa unicolor, Terpsiphone paradisii, Anthreptes singalensis, Arachnothera robusta.*

iii. Species found on Benom at 600–1000 ft, absent at Kuala Lompat (200–250 ft): *Ictinaetus malayensis, Microhierax fringillarius, Rhizothera longirostris, Macropygia ruficeps, Phaenicophaeus diardi, Rhyticeros undulatus, Meiglyptes tukki, Hemicercus concretus, Cymbirhynchus macrorhynchos, Pitta caerulea, Pitta sordida, Pericrocotus igneus, Aegithina lafresnayi, Chloropsis sonnerati, Pycnonotus squamatus, Pycnonotus cyaniventris, Pycnonotus erythophthalmos, Trichastoma sepiarium, Malacopteron affine, Stachyris nigriceps, Stachyris leucotis, Orthotomus sericeus, Enicurus ruficapillus, Rhipidura perlata, Aethopyga mystacalis, Dicaeum trigonostigma.*

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